Practical Text Book of Lithography

WARREN C. BROWNE

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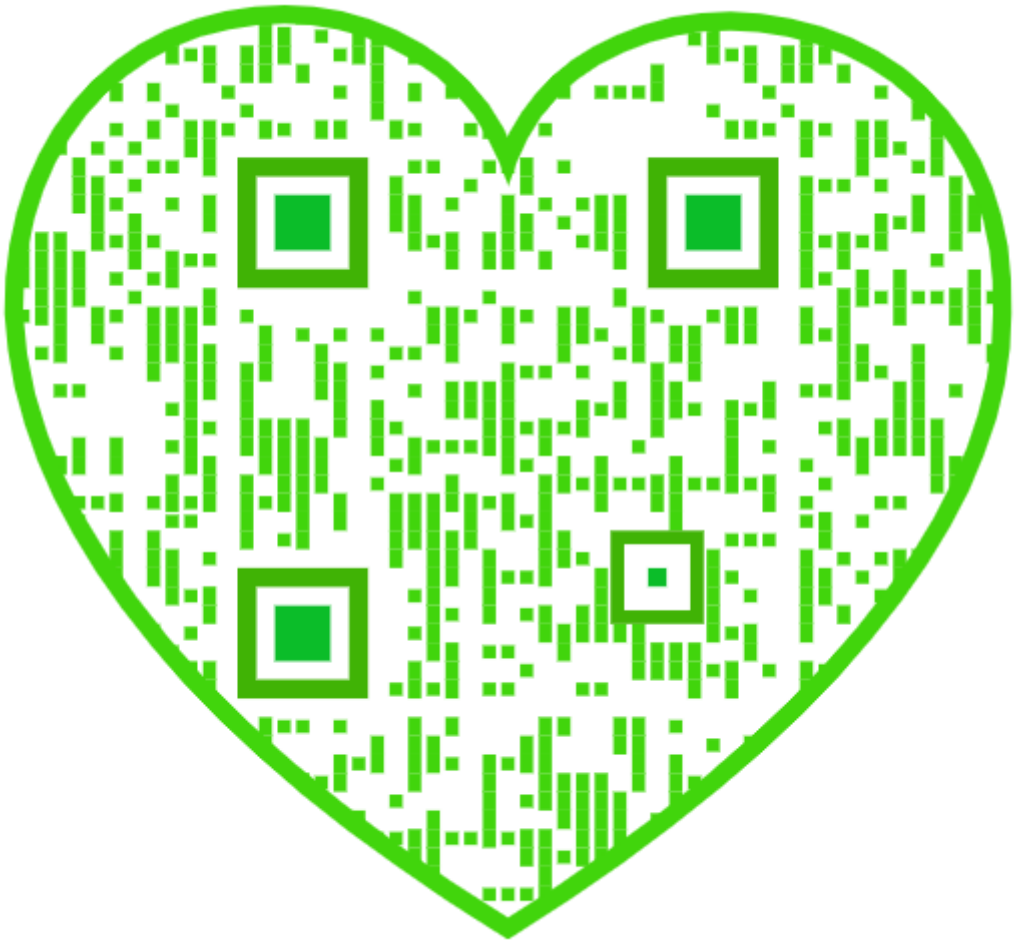

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PRACTICAL TEXT BOOK OF LITHOGRAPHY

A Modern Treatise on the Art of Printing from Stone

BY

WARREN C. BROWNE
Author of "Metal Plate Printing."

Price, $2.50.

NEW YORK:
THE NATIONAL LITHOGRAPHER
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PREFACE

THE object of the following treatise is to furnish both the amateur and professional with a comprehensive text book which can be understood by the workers in lithography whether they have enjoyed a college education or not. There are several lithographic text books on the market, but most of them are so technical that the layman cannot understand them, and even the technical worker has, at times, to consult a dictionary in order to be able to grasp the meaning of the author. The writer has undertaken in the following pages to use only plain, understandable English. Wherever possible, where technical phrases have been called for, there have been substituted equivalent phrases of the plainest English. In this way has the Practical Text Book of Lithography been made as lucid as it is possible to make a work of this kind.

In offering this book to the lithographic workers the writer believes that he is benefiting the art. He makes no pretense of originality, because the process was discovered and perfected before he was born, but there has always been a demand for a concise, clear and practical text book to which the worker could turn when a question arose as to the best mode of procedure. We believe that this book will meet that demand.

WARREN C. BROWNE.

New York City, 1912.

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TO ALL

WHO SEE IN LITHOGRAPHY

Art

AND DESIRE ITS DEVELOPMENT

THIS BOOK IS DEDICATED

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CHAPTER I.

Definition and Principles of Lithography.

THE word "Lithography" is formed by a combination of two Greek words, the first, "Litho," meaning stone, and the second, "Graphy," meaning to write, and the free translation is "to write on or from stone." Lithography, then, is the act of writing or drawing on stone and the process of reproducing such writings or drawings on paper or other materials.

There are two separate and distinct methods of preparing the writings or drawings for reproductions by the lithographic process. The first, which is used in practically all commercial—or black and white—work, consists of the work of the artist, which is generally done on paper in the regular or "positive" way, and then reproduced on an engraving stone by the engraver, who engraves or scatches the image or lettering into the smooth surface of the stone in reverse or "negative" for the stone press or the direct printing rotary. For the rubber blanket offset press the engravings are made direct or "positive."

When the engraving is finished another mechanic, known as the transferrer, takes it and pulls a transfer im-

pression from it, which is laid down on the printing stone or plate, ready for the pressman to put on the press and run the edition from.

Another method, which is employed very largely by poster printers, and color lithographers in general, consists in having the image to be reproduced made directly on the printing stone or plate by means of crayons or pencils made expressly for the work. As this method of lithography requires no transfer to get it ready for the press it has to be drawn on the stone or plate in a negative position—reversed from the position it is expected to occupy in the printed matter. This is necessary because in printing from such an engraving or crayon drawing the image or other matter to be printed comes from the stone to the paper in exactly the opposite position it occupies in the original drawing.

To get a clear idea of this reversing process, write your name on a card, using plenty of ink. Immediately press a blotter over the words. Pick up the blotter and you will see your name written in reverse where it comes into contact with the ink on the card. Now hold the blotter before a mirror and you will see your name reflected "direct" as you wrote it on the card. Hold the card before the mirror and you will see your name reversed as on the blotter. Draw the reverse signature on a white card, using plenty of ink as before, and press the blotter upon the fresh ink. The impression upon the blotter will then show your signature direct, as you always write it. Upon this principle of reversing impressions, together with the known properties of certain

substances to retain or reject grease and water, is based the whole principle of lithography.

It is this printing from the stone or plate that really constitutes lithography. It was the discovery of Alois Senefelder, of Munich, made in 1796, that the smoothed surface of a closely grained limestone, found at Solenhofen, Bavaria, was so sensitive that it would absorb either grease or water, but that the water would not, of course, penetrate any part of the stone that was covered by the grease. Taking advantage of this fact Senefelder drew designs with greasy crayons on the stone and then dampened the entire surface with water. Then, when printers' ink, to which a little grease had been added, was applied to the surface of the stone it was found that the ink only adhered to those parts covered by the crayon designs, while the wet surface repelled the ink. Pressing a sheet of paper on the surface of the stone he received a reversed impression of the original design which was on the stone, in the same manner as the blotter showed your name, in reverse. Now, if the design on the stone had been reversed, as on the blotter, the impression on the paper would have been direct.

It is found most practical for commercial lithography, therefore, in printing from a stone, to first draw the design on paper, then engrave it in reverse on stone, and then transfer it to the printing stone by the use of transfer paper.

Not all stones will absorb ink like the blotter, nor will they reject the ink when they are wet. Practically the only stones ever discovered with these peculiar charac-

teristics are those fine limestones found in Solenhofen.

While the discovery or invention of lithography is generally and rightfully ascribed to Senefelder, it is agreed among historians that Simon Schmidt, of Germany, and William Blake, of England, used a somewhat similar process nearly twenty years previous, but Senefelder was nearer the quarries of Solenhofen and he developed the art to a high state of perfection. Through pupils and apprentices the business soon spread throughout Germany, France and England, and was later brought over to America.

For many years after its discovery lithography was done by hand. The hand press is still used for proving and occasionally for short runs, but mechanical ingenuity has devised fast running, steam driven presses, on which many thousands of impressions per day can be printed.

The most modern of these steam driven presses is known as the Rubber Blanket Offset Press. The process used on the offset press is practically the same as for the stone press, except that the image is put down on a metal plate from which it is transferred in the operation of printing to a rubber blanket and thence to the paper.

CHAPTER II.

Preparing the Stone.

LITHOGRAPHIC stones are compact homogeneous limestones, sawn at the quarries into slabs of 3 to 4 inches in thickness and in area from 6x8 inches to 44x62 inches. They are mostly imported from Solenhofen, Bavaria, Germany, and vary in color from a light cream, dull yellow, drab or gray to darker shades of the same colors. The light tints are softer than the dark, and the gray are harder than the cream-colored stones. Some are uneven in color, having light and dark patches, which render them unfit for drawings of which the artist requires to see the effect he is producing during the progress of his work; but for ordinary transfer work this appearance is usually unimportant, as also in show-card and other simple ink-work. Chalky stones have light spots scattered about in patches, or these may occur all over the stone; these places are soft, and render the stone unfit for any but the commonest work, and should never be used for chalk work, because the acid used in etching attacks those parts with greater energy, and produces similar spots in the impression. For the same reason they must not be used for etched tints.

Among the ordinary defects of stones may be mentioned holes, and specks, termed pins. The latter are

hard points, usually of a dark color, but are not of very frequent occurrence, nor of much disadvantage in use. Neither chalky stones nor those having holes will do for engraving upon.

Veins are frequently found, some of which are scarcely visible, while others are not only broader but sometimes contain patches which distinctly show their crystalline character.

While any stones of the description before mentioned will do for common purposes, great care should be exercised in selecting those required for particular work. This advice pre-eminently applies to chalk-work, in selecting stones for which preference should be given to those of an even gray or drab color; and though these are not of so agreeable a tint to the artist as the lighter ones, yet experience has shown them to be the best for the purpose of chalk drawing.

No other surface yet discovered fulfils the necessary conditions of lithographic drawing and printing so completely as the Bavarian limestone, yet other substances are in use, possessing advantages peculiar to themselves; the most important of these being zinc plates, and the chromatized gelatine films used in the Albertype and other kindred photo-mechanical printing processes.

Grinding.—Before the stone can be used it requires to be ground and polished. For this a stone trough is used as a convenient rest for the stones during the operations of grinding, polishing, and graining, and as a receptacle for the waste sand, water, etc. It should be emptied at least once a week. Many jobs are spoiled through want of care in using clean water.

The trough may be made of wood, 1½ to 2 inches thick, and about 11 inches deep, and about 4 feet by 3 feet in area. It may be lined with zinc or lead, preferably the latter, but if well jointed it will do without either, as the water will keep the wood swollen. It should be placed on a strong stand about 18 inches high, and if the trough be ledged at the bottom, the ledges may be so contrived as to keep the trough in its place on the stand. It is better to have the trough and stand made separate, as the trough is then easily lifted off the stand if required, while it can be made equally firm as when constructed as one piece. Four or five cross pieces about 4x2 inches, notched two inches deep at the ends on the under side to keep them in place, and a groove across on the upper side about 2½ inches from their ends to prevent the water running over the trough, will serve to hold the stones during the operations of grinding, polishing, etc. Where convenient, the water should be applied from the main or a tank, terminated nearly opposite the centre of the trough by two or three feet of india-rubber pipe, to which should be attached a three-inch nozzle. Where this cannot be done, a shelf must be provided for a bucket of water, and a jug or other handy vessel kept for pouring the water over the stone. A tap should be placed in a convenient position about two inches above the bottom of the trough, by which the water can be drawn off, and the sediment may be taken out afterward with a small hand-shovel or similar tool.

Emery and flint sand are both used for grinding, but for a finer surface French red sand, an importation from the Mediterranean, is used. It is of a warm creamy color.

The *Levigator* or *"Jigger"* is an instrument of cast iron about ten inches in diameter, with holes passing from the top through it. It is surrounded by a rim, and has a handle placed eccentrically at about one-fourth the tool's diameter from its edge. It is used for grinding purposes by strewing sand and water over the stone and on the top of the levigator, which is then set in motion by grasping the handle and performing rapid circles all over the stone to be ground.

Sieves are used for sifting the sand previous to grinding and graining. They are of fine woven wire gauze, preferably of copper, but usually of brass, mounted in wooden hoops. They must be carefully kept in a dry place, as they are very easily injured. Damp air corrodes the brass and makes it rotten. If a few broken places occur, they may be repaired by gumming over the holes with small pieces of paper, or otherwise preventing the sand passing through such faulty places. Sieves are numbered according to the meshes per lineal inch. No. 60 will answer well for ordinary grinding purposes, preceded, if necessary, by No. 40, when much grinding has to be done. No. 120, the smallest size made, will be necessary for ordinary fine grains, and No. 100 for coarser grains.

A straight-edge will be necessary for trying the surface of the stones. A very useful article may be made by selecting a piece of iron three or four feet long, two inches wide, and one-quarter inch thick, and sending it to an engineer to be planed along one edge, so that it will stand upon it. A stone may be considered true enough if a small piece of writing-paper is held by the straight-

edge at each of several places along its edges and middle when the straight-edge stands upon it.

The back of the stone should be tested also, and made generally level, if found not so. Breakages are the result of inattention to this, as stones break in most instances by reason of the backs not fitting the bed of the press. If the upper and lower surfaces of a stone are two parallel planes, no amount of pressure applied in printing will break it. The press may be broken, but not the stone. Any lumps may be taken off the back with the chisel and mallet, and if necessary, finished by the levigator. Yet, when every care is taken with the back, if the face is not parallel to it, the printer may by clumsy packing reduce it to the condition of an uneven back, and break it in consequence.

The grinding may very satisfactorily be done without the levigator by grinding smaller stones on larger ones, moving them about with a circular motion, and keeping them fed with sand and water, having first one side towards the grinder, and then another, going over the edges and corners of the under stone to prevent the latter becoming hollow, and being careful not to allow the stones to rest for an instant in one place. If not kept in motion the cohesion may become so strong, owing to the exclusion of the intervening air and the vertical pressure of the atmosphere, that there will be difficulty in separating them. Rub the last lot of sand down finer than the previous ones and that will save time in the next operation. Two stones containing one square foot each should be ground on a stone containing two square feet, and so on in proportion; but if the under stone has been lying

with the ink upon it longer than those to be ground above it, a proportionate number may be done upon it as a compensation. After completing one upper stone, try the under one with the straight-edge, and use the next stone in such a manner as to render the under one level. This will be found an excellent and practical method; but where the stone is too large to be easily moved by hand the levigator may be resorted to.

In large establishments stone-grinding machines driven by steam-power have been adopted. These do their work in a very satisfactory manner, but they must not be expected to keep the stone perfectly level without care and intelligence on the part of the stone-grinder. The stones will require testing with the straight-edge the same as if they were ground by hand. Stone-grinding machines usually work on the levigator principle, the chief difference between them and hand-work being that in the machines the stones are kept moving as well as the levigator; while in hand-grinding they are stationary, and the levigator only is moved. In a machine recently introduced the levigator principle is omitted, the stone being ground face downward upon a revolving iron table. No doubt these self-acting mechanical movements are well designed for keeping the stones as level as machinery is likely to accomplish; but, as before stated, they must not be relied upon entirely. These remarks apply very forcibly to stones for machine-printing. The cylinder of the printing-machine cannot be adjusted to the stone as the scraper of the hand-press may be, so that it is essential for equality of pressure that the stone be true on its face, even if its upper and under surfaces are not strictly parallel.

Polishing succeeds the grinding, and is commenced by taking a large piece of pumice-stone, filing a flat piece at right angles to its fibre, and rubbing the stone with it and with water from end to end, or, if the stone be too large, across it. Take the pumice-stone in both hands and press firmly on it from the shoulders, exerting the principal pressure as it is pushed from the person, which should accompany the motion of the hands. Light, quick rubbing has very little effect. The use of the pumice-stone must be continued until the sand-holes have disappeared. The scratches caused by the pumice are then taken out by the snake-stone, known also as Scotch stone or water of Ayr stone, which is used in a similar manner; but instead of keeping a flat face, a kind of rocking motion is applied in using it, thereby forming a curved rubbing surface that cuts more quickly. More water is necessary in using the snake-stone than the pumice requires, because the adhesion is so great that the fluid is pushed before it, while the pumice-stone is porous, and carries the water with it.

A finer polish may be given by using a woollen pad and finely powdered pumice-stone; but the other method, when well done, gives a sufficiently good surface for all kinds of work. For fine ink-work, engraving, chalk transfers, and transfers from finely-engraved plates containing tinting, there should be no scratches seen under a magnifying-glass of such a power as is ordinarily used for viewing photographs, etc.; but for the general run of commercial lithography the scratches commonly met with are of no importance. The same remarks apply to sand-holes, which, for the delicate styles of work before mentioned, should be carefully looked for.

Subsequent to the grinding, a rasp, followed by a fine file, is necessary to give the stone a curved edge for about half an inch all round, finishing with pumice and snake-stone, which should be kept for the purpose, because the edges will spoil the flat surfaces of those used for the flat-polishing. In stones for the machine, this part requires great attention, and more of the edge should be taken away, especially on that side that comes nearest the grippers.

After polishing, it is very essential that the stone be thoroughly washed.

In cases where a stone is wanted immediately after polishing, it may be warmed and dried very rapidly by pouring hot water over its surface, taking care not to apply too much at a time at one place. The water soon parts with its heat; and when the stone is sufficiently warm the water may be struck off with the squeegee. The stone will then dry rapidly, because little moisture remains upon it to be evaporated.

The squeegee consists of a piece of india-rubber a quarter of an inch thick, about two inches wide, and any convenient length, set in a frame with about one inch of its width projecting, being mounted just in the same manner as the modern ink-erasers and paper-cleaners. When a stone is polished and washed, one or two strokes of this instrument will denude it of all surface water more effectually than any other method, and it is far superior in every way to either the use of blotting-paper, rag, or setting the stone on end to drain.

This is all the preparation needed for that kind of lithography usually called "ink" or "line work," which is

executed on polished surfaces, but for chalk or crayon work the stone must be grained.

Graining.—Take a stone free from all veins, marks, and chalk-spots, and, if for best work, of a clear gray or dark drab color. Grind it and pumice it free from any deep scratches. Now take a piece of stone similar to the one to be grained, about three or four inches square, with the corners and edges well rounded off with a file. From a sieve (No. 100 or 120, according to the grain) sift sufficient graining-sand to lightly cover the surface; sprinkle a few drops of water over it, and place upon it the graining "muller." Move this about with a motion describing small circles along one edge; then return at about three inches from the edge; back again at about six inches from the edge, and so on, until the stone has been gone all over. As the work is proceeded with, more water will be required; and as the sand wears out, more of that will be needed. If the stone be finished off with sand that has been but very little worn, it will probably produce a grain too coarse and sharp, while a contrary result will follow the using of the sand for too long a time, the grain then being "flat."

When dry, place it obliquely at a window, and with a magnifying glass seek for any scratches. A scratch or two may be of no importance in some jobs; in such case consult the artist, who will know. If they prove vexatious, the stone must be gone over again. The stone should now be of a vellum-like texture all over, and the artist may try the grain with a crayon at various parts of the stone, making little patches of light tinting. These will not often interfere with the work, because they will

either be absorbed in deeper tints, or may be scraped out in the finishing. If the artist is satisfied with the grain, the grainer's work is done; if not, it must be sought to know what the defect is.

This grain is most essential, not only in giving clearness of texture and transparency in the impressions, but, by reason of its hardness and sharpness, acting as a rasp to take off a sufficient quantity of crayon to give blackness and body to each dot. If the crayon be drawn over a polished stone and over a grained one, it will be found that the stroke in the former case is poor and gray, while in the latter it is bold and black. The former is nearly destroyed by an etching that the latter will stand well; for this reason, it is desirable to have a sharp grain.

Good results have been obtained by a method of graining which was introduced a few years ago. In this process the grain is produced by sprinkling the surface of the stone with sand and rolling it with small glass balls. These balls having a limited area in which to work exert a continuous cutting power without any tendency to produce scratches. Some mechanical arrangement is necessary to impart this continuous rolling movement to the glass balls and to maintain a uniform speed. It is quite easy to understand that with such a process, carried out under favorable conditions, very fine results might be produced with great rapidity.

It is often profitable, instead of using new stones, to grind off a design which has been printed and which is not likely to be wanted again. A list of these "dead" designs should be in the hands of the foreman grinder, and when wanted it will be well for him to scratch a

cross deeply into the stone, making the scratch deeper in those stones that have been standing the longest with work upon them. This gives the stone-grinder to understand that the cross must be ground out. It is a simple matter that will save the printer's temper and the master's pocket by insuring the thorough grinding of the stones.

It is astonishing to what a depth the stone is affected by the greasy particles of the ink without being perceptibly greasy. The residuum of the ink acts also by preventing an equal absorption of water and gum with the rest of the surface, so that this part, drying soonest and being less protected by gum, favors the spreading of any work that might have been drawn or transferred over it. It is very annoying to the artist to see a nice even chalk tint spoiled by the influence of the old job causing every speck of chalk to become thicker at that place; very vexatious to the master who has perhaps to pay for a new drawing, and very discreditable to the stone-grinder, whose carelessness has been the cause of it.

CHAPTER III.

Ink Drawing on Stone.

WORK IN REVERSE.—The principal difficulty experienced in drawing and writing on stone arises from the necessity of reversing the work, and this, conjoined to the drawbacks of always having to trace work to the stone, and the great bulk and weight of the latter, places working on stone at a disadvantage in comparison with transfer-paper; on the other hand, the accidents to which transfers are liable cause stone to be more generally used in most establishments.

For drawing upon stone and transfer-paper, the artist will need all the usual appliances of the draughtsman's office, but he will require to have the ruling and circle pens in more than usually good condition. In addition, he will require brushes and pens of a finer character than those required in any other kind of drawing.

Transfer-paper is more suited to the use of the writing pen than stone; but for the brush, crayon, and mathematical work, the surface of the stone is to be preferred, and it will hereafter be shown that it allows of a greater variety of work than the transfer method.

Transfer-papers are prepared by coating the surface of paper with gelatine, starch, or gum, either singly or in combination, or united with other substances. The object

of this coating is to interpose a soluble film between the writing or drawing, in lithographic ink or chalk, and the paper. Paper being more or less porous, would, if used alone, absorb some of the ink, instead of permitting the whole of it to be transferred to the stone. Hence the necessity of covering it with some substance which, during the process of transferring, can be moistened through the back of the paper, which is then peeled off, and the work, with the whole or part of the mucilaginous film, left upon the stone.

There are two distinct kinds of transfer-paper for drawing in the ink style and writing, one prepared on ordinary paper and the other on transparent or tracing-paper. These have smooth surfaces; but the transfer-paper for chalk drawings has a finely granulated surface adapted for receiving the lithographic crayon. There are also transfer-papers for taking impressions from copper-plate, type, and designs upon stone, to be transferred to stone for the convenience of printing more impressions at once than that obtainable from the original alone.

Water is used for dissolving the ink for writing or drawing on stone or paper; and inasmuch as soap is used to render the other materials of the ink soluble, it is important that hard water should not be used, but distilled or rain-water filtered through blotting-paper. A four-ounce bottleful, with a nick cut in the side of the cork so that it may be shaken out a drop at a time, will last for a long while if kept for the purpose.

Tracing-Paper for making clean and neat copies of the work to be done, and *red* tracing-paper for transferring the same to the prepared paper or stone, will be re-

quired by the artist. The qualities and uses of transfer-paper are fully described on page 219.

It is well for the student to devote a certain number of hours per week to a definite study of lettering, ornamental designing and freehand drawing. In the first instance it will train the perceptive faculties and draw out such talent as may exist. A thorough knowledge of forms, shapes and values can only be obtained by close training. In lettering, the Roman, Old English and Script forms should be studied and practiced, and in ornamental designing small forms, such as flowers, leaves and chain work, are highly useful and decorative. In drawing from life, the ideal proportions of the human face and figure should be thoroughly impressed on the memory of the student, and each slight variation from those ideal values or standards should be immediately noticed and recorded.

A study of the ideal, as exhibited in the casts and statues found in all art rooms, can not but be of great service to the student. The public demands art in all forms of lithographic work, but with the artistic value thoroughly evident, the public also demands that all work be pleasant and attractive to the eye.

This can only be accomplished by a thorough study of ideal forms, and a subsequent training to that of the art school can be found in all outdoor life. The step here should advance from black and white to colors. A great assistance to a knowledge of proper color mixing can be obtained by the use of a simple box of water-colors; six colors with white and black are ample for this purpose.

The Tracing.—In proceeding to work upon stone, the student must bring himself to acknowledge and appreciate

the value and importance of a good and correct Tracing, and feel assured that nothing can be gained by neglecting so essential an aid to success. It is made either in pencil or ink, placed in the reversed position upon the stone, and the red chalk tracing-paper with its prepared side downward, is interposed between it and the stone. The corners are now gummed, pasted, or held down by paper-weights (avoiding the use of wafers), and the work traced over with a 3-H pencil, or other hard tracing point, until a facsimile, in red, of the tracing, is transferred to the stone. In this manner all kinds of work are put upon the stone in faint red outline for whatever purpose it may be required, and whether the stone be polished for drawing, or grained. Other methods of tracing, applicable to photographs, pictures, and subjects requiring greater transparency than ordinary tracing-paper possesses will be found in the chapter devoted to Miscellaneous Processes.

The tracing having been made, the student may proceed to apply the ink by which the stone is made capable of multiplying the artist's ideas. This ink may be applied either by the brush, steel pen, or the mathematical pen.

To Prepare the Ink.—Take a small white delft or china saucer or a small tin patty-pan about three inches in diameter, and having warmed it at the fire or over the gas until it is as hot as it can well be borne in the hand, rub the stick of ink round and across it so as to cover it thinly. Then out of a bottle shake a few drops of water, and with the second finger of the right hand rub it until the ink is dissolved. Then add more water cautiously, until it is brought to a proper consistency for use, which can only be

learned from an adept, or by experience. If it is very pale and flows too freely, it is too thin and may not transfer properly; if too thick it will not work pleasantly, and will spread in transferring. As a rule thinner ink may be used with the writing-pen than with the brush. When the brush only is used, put a small bit of ink in the upper part of a saucer placed upon a slope, and a little water in the lower part. The brush may then be dipped in the water, rubbed upon the ink, and tempered upon the dry portion of the saucer until it becomes fit for use.

Tusche.—The most useful of all inks for writing or drawing on stone come under the name tusche. This ink was originated by Senefelder and has now been brought to great perfection by Lemercier, of Paris, and Korn of New York. The proportions are, practically speaking, standard, and contain four parts wax, four parts shellac, four parts tallow, four parts soap, and one part lamp-black. In the making of this ink great care must be exercised, as an improper combination or an excessive burning would ruin the mixture. The purpose of these different ingredients is to make an ink which can be rubbed down with water and used with either the brush or pen, and it is of such a nature that it will penetrate the stone, changing its composition to oleo margarate of lime, and at the same time drying with a firm, glossy surface which will perfectly resist the action of the first etching solution.

Lithographic Brushes are good red sable crow-quill pencils, with a portion of the hair cut away all round, so as to allow only the central part to be used. If any single hair protrudes beyond its neighbors, the brush will not be

good, but this may in part be remedied by wetting it and passing it rapidly through a gas flame to burn it off, the wetting protecting the rest and exposing the single hair only to the flame. It is not every pencil that will make a good brush, so that when one is obtained it should be treasured. It is well to possess some half-dozen or more, as a brush that will not do for one purpose may do very well for another. Brushes are made that are intended to be used without cutting, but they are generally made of too fine hair, and are not sufficiently springy and elastic. Some artists make up their own brushes by cutting off portions of a larger red sable pencil and tying them to suitable pieces of cedar-wood and then mounting them by any convenient means. A practical method of preparing the brush is to dip it in gum-water, draw it to a fine point, and let it dry hard, remove the outer hair with a sharp penknife to the degree thought necessary and wash out the gum. This often produces a first-class brush, but the method has the disadvantage of not permitting it to be tried at intervals during the operation. No more hair should be removed than is necessary to produce a brush suited to the particular work in hand.

A ready mode of mounting brushes is to attach them to pieces of wood in such a way that a quill may be used as a cover to protect them when not in use, and to form the handle when required. This is similar to some pocket penholders, which, by the way, may be adapted to the same purpose.

In addition to the brushes used in drawing and writing with the lithographic ink, others of a coarser kind (duck and crowquill red sables) will be required for various pur-

poses, such as "stopping or gumming-out," making colored sketches, etc.

A flat camel-hair brush about two inches wide will also be wanted to remove any loose particles of dust or dirt from the surface of the stone or transfer-paper while at work.

Lithographic Pens.—All ordinary pens are useless for any of the finer purposes of lithography, such as circular and ornamental writing and drawing.

If the work is not *very* fine, Perry's pens will be found to answer the purpose, and they may be further improved by delicately sharpening them on Arkansas oil-stone.

The use of steel pens was known in the early days of the lithographic art, and the mode of making them is thus described by M. Bregeaut in a work published in 1827, and by Senefelder in 1819, in his "Complete Course of Lithography." The language differs, but the description is even fuller.

"Take a watch spring, and get rid of any grease that might have adhered to it, by rubbing it with some fine sand or a soft piece of pumice-stone; place it in a dish, and pour on it equal parts of nitric acid and water; allow the acid to act on the steel, until it has lost three-quarters of its thickness, and is reduced to about the substance of a sheet of paper.

"During the action of the acid, the spring must be taken out occasionally and wiped with a rag, to render the action more equal.

"When of the proper thickness, the spring must be well washed and wiped, and cut into lengths of about one inch and a half. Each piece must now be rounded in the shape of a gouge, by placing the steel on a piece of cardboard laid upon a lithographic stone, and striking the steel with the small end of a hammer, lengthways; by this operation the steel will take a curl.

"A small and sharp pair of scissors must now be taken and the slit made with them at one extremity of the piece of steel; each side of the pen must next be shaped with the scissors: the difficulty of the operation consists in forming each nib perfectly equal and with a very fine point: great practice is required in making a good steel pen."

Steel of the proper thickness for such pens may now be obtained of dealers in lithographic supplies. It is a good plan to put the steel between a wooden holder and a quill, so that when a new pen is required the steel may be drawn down, the old nibs cut off, and new ones made.

In forming these pens a pair of small forceps will be found useful in setting the nibs in their proper position.

With these instruments almost any kind of work may be accomplished that partakes of a freehand character. To use them properly requires considerable practice; but a few hints may assist the tyro who is making his first attempts. The brush must be dipped into the ink, the superfluity removed by drawing it over the edge of the saucer, and a point finally given to it by patting it, as it were, upon a piece of smooth paper, the thumb-nail, or other similar clean surface. It may now be applied to the stone to produce what the draughtsman requires. It must, to produce fine lines, be held so that only the extreme point touches the stone. At first the student may content himself by placing the stone in such a position that he can make the lines by drawing the brush towards him. He will soon find, however, how far this system may be departed from, and that some brushes will permit of much greater freedom of manipulation than will others. Thicker lines may be drawn by greater pressure upon the brush, more being required as the ink in it

approaches exhaustion. On account of the delicate structure of the brush, the ink in it will require frequent renewal, and much patience will be wanted on the part of the young artist, who will in all probability be tempted to work faster than consistent with the object aimed at, this manipulation of the brush to bring it into working condition occupying a considerable amount of time.

In tinting, the student should not endeavor to make a long line at once, but to effect his object by a series of short ones. In doing this, however, he must avoid making ugly gaps between each set, though good effects are sometimes produced by leaving such places, and afterwards stippling them. The study of good bold etchings by some first-class engraver on copper will do much towards forming a good style; but the peculiarities attending this style of drawing should never be lost sight of. The etcher on copper and steel has this advantage: he can re-bite his work, and make it darker if his first proof is not satisfactory; but the lithographer must get the effect he desires before he passes the stone to the printer for proof. Nevertheless he has the advantage of easily getting heavy masses of *black,* which he can lighten either with steel or diamond points, and thus produce effects similar to woodcuts.

Tinting by means of irregular waved lines is easier to perform than by straight lines, and the effect is good if suitable to the subject. Mathematical precision of course must be avoided, but it must be done with some amount of regularity to look well. The convex side of any curve in a line must not be opposite the convex side of its companion line, but opposite its concave side, so that

though the lines may be really irregular, yet the general effect may be that of parallelism.

The steel pen spoken of in a preceding paragraph may also be used, and will be found especially useful in foregrounds, near foliage, etc.

The mathematical steel pen will at first require much practice and attention to master it so that very fine lines may be made with it; but this tool, as also that for making circles, is of the very greatest importance in all branches of lithographic drawing; therefore it is quite essential to master any difficulties that it may present.

It is usual among lithographic draughtsmen to put in any dotted lines with a continuous stroke of the pen, and afterwards to scrape them in such a manner as to make dotted lines of them. While fully admitting the neatness of this method, we must be permitted to point out some attendant defects.

1. The scraping is liable to be omitted.

2. If insufficiently scraped, the lines roll up again; and, if deeply scraped, the proofs show an unpleasant embossing at that part. And

3. They often look too thin and ineffective when one half the line is thus taken away.

In consideration of these points, we rarely make use of the method, as we find no difficulty in dotting them as we proceed, with good ink of proper consistency. If the ink be too thin, all ruled lines have a tendency to run thick at the end of the stroke when using the ruling pen, and this is aggravated when making the short strokes of dotted lines. The student may therefore make this a test when preparing his ink.

The learner may find it useful to have the margin of the stone to practise upon, but it is not to be recommended to the practical lithographer. If the edges are gummed over with thin gum before commencing it will save the printer a good deal of trouble.

To assist the student in reversing his drawing, he will require a looking-glass of any convenient size. It should have a piece of wood or other contrivance attached to its frame, by which it may be made to stand pretty securely on its edge. A finely polished steel or silvered copper plate, or a piece of glass silvered by the chemical method will be found superior to ordinary looking-glass, as there is then only one reflection, while when the ordinary mercurial silvering is used there are two—one from the metallic surface and another from the outer glass surface.

Writing on Stone for Circulars must of course be reversed, and the first essays of the learner may be assisted by tracing; but, as tracing for this purpose is inadmissible for real work, the sooner it is laid aside for the next stage, the better.

Proceed by sketching out rapidly in pencil, or paper, the words of the circular, so as to see how much space it will occupy.

Now lay out and mark a space on the stone, and, having fixed upon the size of the letter, rule the stone with the before-mentioned tool into a series of double lines, to correspond to the sketch. Across these rule any convenient number of single lines at an angle with them, of from 45 degrees to 50 degrees, as a guide for the slope of the letter. Now, having first obtained a good specimen of copper-plate or lithographic writing, by the help of the

mirror consult its reversed position, and carefully copy each letter by means of a fine lithographic brush. It will be as well to sketch them out, but more especially the capitals, by the help of the pin-points, and, as confidence is gained, sketch the capitals only. It will be found that both the up and down strokes of the writing must be made with *down strokes* of the brush; make the down stroke, and then add the up stroke. Much practice will be necessary, and, as the plan-draughtsman on stone *must* be able to letter backwards, it will be only a further extension of his skill to be enabled to write a circular.

When the lithographic student has mastered the difficulty of writing backwards, and is able to produce a decent circular, he may proceed to do without such of the before-described helps as his skill will permit of.

It is not necessary always to write directly on the stone.

In this case we will first take up a prepared sheet of transfer paper No. 1, fasten it with thumb tacks to a drawing board and rule in straight, equal lines, about one-half inch apart. Use a good grade of writing paper.

Using a new, clean pen in a suitable holder, and with a bottle of autographic ink. A stone should be prepared by grinding with emery or flint and then Schumacher stone, then pumice stone and Scotch stone. When thoroughly cleaned with pure water and put on end to dry, it is fit for use.

The press being ready, cleaned off, oiled, and in thorough order, a good black roller, scraped, and freshly mixed ink easily at hand, the stone should be put in the press.

A suitable scraper, which has been made to size of stone, is tested by laying the edge of same on stone. By looking between the surface of the stone and the edge of the scraper, any inaccuracies of the scraper will be readily seen. The surfaces can be made to fit by rubbing the edge of the scraper on No. 3 sand paper.

A good way is to place a clean sheet of paper on face of stone, then the sand paper, and, by moving the scraper backward and forward using moderate pressure, a fairly true edge will be obtained.

A piece of scraper leather about an inch wide and about two inches larger on each end than the scraper, is soaked in water and then tightly stretched over the face and tacked at either end, the smooth side being placed toward wood and the rough side out. Two sheets of super paper used as a backer, and a sheet of thin zinc used as tympan, will complete the preparation.

A suitable pressure having been obtained by lowering or raising the impression screw, the surface of the stone should be dampened with spirits of turpentine, using only a clean rag for that purpose.

With the sheet dampened, and the turpentine spirit evaporated, the circular should be placed face down on the stone in a suitable position, either for hand or power work, and pulled once through the press with stiff pressure.

It will then be found adhesive only in a slight degree to the stone, and should be lifted off and the stone "gummed in" with gum arabic solution.

When dry, the gum can be washed from the stone, using a clean sponge. Then by means of dampening the

stone and inking up with the black roller, previously prepared, the written lines will have shown themselves to be capable of taking up the ink from the roller.

As the gum has penetrated the stone where there was no writing, these parts will remain clean, and so long as properly dampened will repel ink.

When the written part has been firmly inked, it may be dusted with finely powdered resin to protect it from the action of the acid solution, which is next applied to the whole surface of the stone.

The gum itself is sufficient preparation to keep the stone clean for possibly five or six impressions. The addition of nitric acid makes this preparation more sure, and, with careful working up, five hundred impressions can be made from the single etch.

The use of a camel's hair brush for the purpose of etching is to be commended, as camel's hair can withstand the acid for a longer period than any other brush we know of, and at the same time is always soft and will not harm the most delicate lines of drawing, if properly taken care of.

The acid solution should now be removed from the stone by washing with clean water, and stone gummed in, when it is ready for printing.

The purpose of this repeated gumming is to prevent any grease from coming in contact with and soiling the surface of the stone.

The gum not alone penetrates the stone but also forms a coating on its surface retentive of water.

When dry, the gum may be again washed from the surface with water, the ink washed out from the transferred circular by turpentine.

A little water is then added, and the rag used to wash the ink out lightly moved over the stone, thereby imparting a little of the ink to the drawing.

The roller may now be smartly passed over the stone, and as long as the stone is kept slightly but uniformly dampened the gummed surface will refuse to ink, and the transferred part will take it.

Suitable marks being then drawn on, or scraped in the stone, as a guide to the correct position of the sheet, the paper may now be laid to those markings, the backer placed over same, the tympan placed over the backer, the press pushed forward, pressure applied by bringing down the lever to a proper position; then, by placing the left-hand palm uppermost and the right-hand palm downward on handle, press may now be pulled through for the making of the print or impression.

Experience shows that the more uniformly the stone is dampened, and that the more rapidly it is rolled, the better are the results.

After three or four sheets have been made, the workman should as nearly as possible count the number of times required in passing roller over the stone to get good results. The same holds good of dampening by hand.

With respect to the question as to which method (stone or transfer) is best in practice, it will usually happen that the subject is practically beyond the control of the employer. He may have a clever general hand, and must be guided by his attainments, while if he engage a circular-writer the probability will be that he will be a transfer-writer. The general question may be disposed of by saying that the transfer method is quickest, but more

liable to accident; while the writing upon stone is usually more firm, will yield perhaps more impressions, and is liable to no accident that is not equally likely to happen to a transfer *after* it is upon the stone.

Ornamental lettering may be practiced in a similar way, but all large letterings, etc., should be treated as drawings, a complete sketch being made and traced to stone. They are to be outlined, in their straight parts, with the ruling pen, and the large letters on show-cards, etc., may advantageously have the compass-pen employed upon their curved portions.

White letters upon a black ground are produced by using a mixture of gum-arabic solution and vermilion acidulated with a little nitric acid. It must be made as wanted, because when once dry it cannot be properly redissolved by reason of a chemical change in the gum produced by the action of the nitric acid. The more acid is added to the solution the more decided is the subsequent insolubility. Experience must be the guide for the proportion of gum, pigment and acid.

Perfection will be attained in the mixture when it works pleasantly, and shines upon the stone after drying. The letters are to be made with this preparation. If the letters are of a kind to admit of the proceeding, it will be found very advantageous to first rule a strong line at the top and bottom of the line of lettering, in litho. ink. The gum mixture not dissolving, the ink will not penetrate through it to the stone, and the result will be a straightness and definition which could not be hoped for without such assistance. When dry they are to be covered over with litho. writing-ink dissolved in spirits of turpentine or

other convenient fatty matter. When the job is complete and put into the hands of the printer, the water will dissolve the gum and leave the letters clear upon a black ground, the result being not only more rapid but more satisfactory than when the ground is painted in and the letters are left white upon the stone.

Stopping out for transferred machine ruling is effected in a similar manner, but no acid must be used, because it would partially obliterate the drawing over which it was necessary to put it. It is useful in plan and other work where lines, &c., are required which would involve great skill and occupy much time to put in by hand, but are easily and expeditiously transferred from machine ruled and dotted plates. Vermilion and gum, free from acidity, is painted over all parts of the drawing that are not to be covered with the machine work in question, and when dry, and a mark put upon the stone to indicate the direction of such lines, dottings, &c., it is handed over to the printer, who transfers a suitable impression, which unites with the stone in those parts only that are uncovered. When the stone is washed with gum-water, if the operations have been properly performed, the effect will be that the gummed portions remain quite clean, and the transferred lines, &c., will almost equal copper-plate, and be very far superior to what hand-work could possibly accomplish.

The Sprinkled Method is effected by taking a quantity of litho. writing ink in a tooth, nail, or other similar brush, and drawing it across the blade of a table-knife or other like instrument, over that part of the stone to be sprinkled. The sprinkling is confined to proper limits by

having all other parts "gummed out." When the first light tint is sufficiently strong, the parts required to be kept at that strength are "gummed out," and, after drying, the process may be repeated until the desired effect is obtained. The operation requires care, and trial should be made (at each renewal of ink in the brush) upon a piece of paper, to be sure that the dots are of the desired size and distance apart. The less ink in the brush the finer the dots, and the nearer it is held to the stone the closer they will be together. The ink for this process should have the minimum quantity of soap to render it soluble, and therefore less tendency to dissolve and penetrate the gum protection.

The cases in which this style may be used must be left to be decided by the taste and discretion of the artist.

One grave defect of the process is, that though a transparent gum solution may be used, yet the effect cannot be observed during the operation, because all is covered alike with the dottings, the gum protecting the several stages. It is only when the gum is washed away that the effect is seen; if then it is not what is desired, it may be remedied by going over again where necessary—first preparing the stone.

Stippling is a species of engraving which is effected by a series of dots instead of lines. The word has a similar meaning in water-color painting. Though a process more peculiarly adapted to chromo-lithography, it may be occasionally employed in the more modest ink-style now under consideration. It yields a very soft and pleasing effect when introduced to tone the harshness of unhached line-shading by stippling minute dots be-

tween the lines. The dots should be in proportion to the lines among which they are placed, never thicker if possible. When the dots are desired to be very fine, they may be done with the brush; but the pen, of various degrees of fineness in the nibs, will be found a most efficient tool for the medium and larger one.

When a graduated effect is to be produced by stippling alone, the dots must be fine and open, followed by others larger and more close, until they approach a solid black.

Roundness of dot and succession of them in lines are to be avoided, as producing hardness of effect. If a good stippled engraving be examined by a magnifying glass, it will be seen that the dots are triple ones, which conduces much to the *softness* of effect observable in this style.

Corrections on Polished Stones in Process of Work are almost invariably made with a sharp mezzotint scraper. Sharpness of the knife is essential to taking the work perfectly out without going deep into the stone, which must not be done, because the pressure would be taken off at that part in the printing. The part scraped out is certainly not so pleasant to work upon as before, but yet when neatly done the work may be put in again in such a manner as to draw no attention to it as a correction. The over-running of lines at corners and junctions is removed by this means, and lines are usually dotted by the scraper after being drawn continuously.

Where the alteration required occupies much space, and the nature of the work will permit, the best way will be to take the snake-stone and polish the stone where

necessary, when of course it may be treated in the same manner as if no work had been upon it. Small snake-stone pencils, one-fourth of an inch square, will be found useful in getting at small portions, and by means of a file they may be made of any convenient size and shape at point. Such pieces may also be used for finally polishing the stone after scraping.

A lithographic nap-roller facilitates the work of development of original drawings on stone, and becomes an absolute necessity when crayon drawings on grained stones are operated upon. The preparation and preservation of a roller of this description require a more than average amount of care and attention. The best rollers are covered with French calf-skin with a soft, velvet-like nap, and may be prepared as follows. Run the roller in crude castor oil for a short time until the leather becomes soft and pliable, then work out the superfluous oil by repeated rolling in medium varnish, occasionally scraping off the varnish with a broad blunt knife. Continue this for a day or two, then gradually work into the skin some good non-drying black printing ink. The roller thus prepared may be somewhat harsh, but a few days' use will bring it into condition. An occasional application of tallow or lard, say about once a week, will keep the roller skin soft and pliable, and counteract the hardening effect of constant contact with the damp surface of the lithographic stone and the oxidization of the printing ink.

Proving the work of the lithographic artist, though not always an absolute necessity, is a helpful and most important function. In its progressive stage it enables

both designer and lithographer to observe the realization of their color schemes, and to amplify or minimize if necessary the effects they desire to produce. Errors of judgment or of detail can be rectified before the work reaches a more advanced stage. Again, a finished proof offers something of a tangible character for an expression of approval or disapproval, and serves as a useful and helpful guide to the printer throughout the subsequent operations.

This will show clearly the importance of the prover's work, and though it is not by any means an unusual proceeding to *prove up* even the most elaborate designs in the lithographic printing machines, it is, for obvious reasons, more convenient to confine such work to the press. It may therefore be regarded as an intermediate operation, distinctly apart from the preparation of the original drawing which precedes it, and the arrangement for machine printing which follows. The distinctive and pre-eminently the most important feature of proving is the manner in which one color is registered with another; and although the methods usually adopted are of the simplest possible character, the most scrupulous care is requisite for their successful application. It appears to be an almost ridiculous plan, so simple is it, to cut away the angles formed by the register lines after the first printing, and then to place them to corresponding lines on each color form, or to pierce the register lines passing a fine needle through each puncture into corresponding holes drilled in the stones and allowing the sheets to fall into position —yet these operations demand constant care and attention.

Corrections and additions after rolling up.—When an addition is to be made in a place where there is room to use the scraper, remove the surface with that instrument and put in the addition with litho. ink.

When previous work has to be removed polish it out with the snake-stone if there be room; if not, use a sharp scraper, and be sure the old work is well cleared away.

When additions have to be inserted among the work and none is required to be removed, a mode altogether different had better be employed. Without entering into the subject of printing, to which it properly belongs, it will be advisable to lay down the theory on which the method depends.

a. In all lithographic printing the stone is varnished, as it were, with a solution of gum arabic which dries not only *on* but *in* its surface, and is there held so tenaciously that no amount of washing with plain water will remove it.

b. This coating of gum, filling up the pores of the surface, prevents the absorption of ordinary litho ink unless it contains an amount of soap more than usual. This is sometimes added to make work "stand," but it spoils the good working qualities of the ink.

c. It is evident this coating must be removed, and anything that will dissolve carbonate of lime (of which the stone principally consists) and will not dissolve the ink, may be used for preparing the stone previous to retouching, because if the surface of the stone be dissolved the thin gum coating dissolves with it.

Most acids, and some salts, will effect this purpose, but choice is given to the weaker acids of vegetable origin, which form soluble salts with lime. Acetic acid is an old favorite, but citric acid is preferable, and may be used as follows:

Roll up the job as for an impression, wash it well to

free it of all gum that can be removed by that means, using hot water by preference; dry, and apply with a camel-hair brush of a convenient size the solution of citric acid of such a strength as to taste a little weaker than lemon juice; watch it, and if bubbles of gas arise at once it is too strong, and must be washed immediately with clean water. If of the proper strength it may remain about a minute, when it must be washed with clean water. The ink must now be removed by pulling two or three impressions from the one inking, so that the artist in working upon it shall have no superfluous ink to attach to his "hand paper" to be carried about and soil the stone. Any touching-up or additions may now be done with ordinary lithographic ink, which will now be found to work nearly as pleasantly as upon a newly polished stone.

All sponges, &c., used in this process must be scrupulously clean, or success can not be expected.

Solutions of alum and common salt, or sal ammoniac, or both combined, form very good washes for clearing the stone from gum, and they probably act not only by dissolving but by bringing away the gum as the salts crystallize. A very practical method for the printer who requires a job touched up, is the following:—After cleaning the work, roll it up pretty full, and etch with perfectly clean nitric acid and water and clean sponge, which will remove the gum at the same time; well wash, and take off a couple of impressions without re-inking. When dry, send it to the artist to have the corrections made. Gum the stone, and allow it to dry, when the job may be proceeded with.

Precautions to be Observed in Drawing on Stone.—All the cautions given regarding the handling of transfer-paper apply equally to the stone; but the stone being a better conductor of heat than paper, and of greater bulk, condenses the breath of the artist upon it in cold weather, causing him to waste time in drying the stone. It is recommended to place the back of the stone to the fire the first thing in the morning, and allow it to get moderately warm through, when it will be found to keep free from this peculiar annoyance for the rest of day; whereas if the face had been warmed to the same degree only, it would have rapidly cooled again. If it is inconvenient to *warm* the stone in the manner described, a piece of cardboard, about 4 in. by 3 in., of an oval shape, and a bit of twine passed through two holes in it about 1½ in. apart, and by this held between the teeth in such a manner as to cover the mouth and nostrils, will effectually prevent the condensation of the breath upon the stone.

a. In drawing upon stone, remember that friction is proportionate to pressure: therefore, let ruling pens glide over the surface, free from the weight of the hand and arm.

b. The parallel ruler must not rest on the stone, but on pieces of cardboard or folded paper. If the work is small, take a piece of cardboard and cut a circular, square, or oblong hole in it, and use it as a shield and rest for the ruler, &c.

c. Keep the side of the pen that slides against the ruler scrupulously free from ink, and for fine lines the outside also, so that the space between the nibs only may, if possible, determine the breadth of the line.

d. To set the ruling and compass pens, rub them on Arkansas oilstone; examine them carefully with an eyeglass after wiping off the oil, holding the pen in such a manner that the light from the nib ends is reflected to the eye; when each nib is reduced to an equal thinness and equal

length, they may be polished on a piece of leather having a little crocus on it. The nibs being already comparatively thin, care must be taken that they are not rubbed too violently, or an unequal length and breadth will be the result. If this happens, bring them to an equal length by a motion on the oilstone, as if ruling lines, previously to bringing them to an equality of thinness. The Arkansas oilstone should not be mounted, because on such a one it will not be possible to get at both nibs of a spring bow pen. A useful stone for the work may measure about 4 x 1½ x ⅜ inches.

Lettering and Drawing on Paper.—It is advisable that the student should cultivate his judgment and also bring about the necessary skill needed in his business by a proper co-relation of the eye and hand. For this purpose the simplest form is the drawing, enlarging or reducing of the approved alphabets on paper.

For this purpose Roman, Old English and Script and the book of alphabets, old and new, showing about one hundred and fifty varieties from Greek, Egyptian and Hebrew to modern German, French and English forms, will be found of much value.

Having mastered these forms, word-grouping should be practiced, and with diligent application harmonious forms will be created, which will not only be of practical value, but will also prove of benefit to the student and if special ability is shown will open the path to promotion in the engraving and designing departments.

Gelatine Shading Films.—In connection with alphabets and lettering as a whole, the shading machine is of valuable aid. In its principle the shading machine consists, first, of a plate, generally of gelatine, sewn into a frame of wood, on which are impressed a series of dots or lines, as many as 250 different patterns being available made by one maker.

This frame is set into a plate with adjustable, pivoted hinges, these hinges being set into a steel rod of the width of the artist's table, the rod being held up, and adjustable in height, by a pair of small cast-iron posts.

The gelatine film is placed over a pad, and the up-raised design on the surface is inked up by means of small composition rollers.

A good grade of transfer ink, or an especially quick drying ink may be used.

The place where the dots should be impressed can easily be seen through the gelatine film, the stone being generally "stopped out" with a gum solution previous to putting in the shading.

A more simple way is to outline the desired portion with gum and acid, a small piece of twisted paper, a bone folder, a piece of wood or the point of the finger may be used to rub down the pattern at the pleasure of the artist.

Where two rulings are wanted to cross one another this can be done by powdering the first ruling with soapstone powder, then impressing the second ruling in the desired position.

Should rosin be used instead of soapstone powder, the gelatine film on the second application will be found to have removed some of the rosin and ink as well.

Should neither soapstone nor rosin be used, the second application of the film will be found to have left the second pattern strong and the first pattern weak, which would cause an unequal effect to the completed design when etched and prepared.

Soapstone powder is best where more than one ruling

is being put to the stone, for the reason that it takes away any suction or adhesiveness that might exist between the freshly printed ink and the gelatine, and at the same time acts as a fair resist to the etching acid. By means of using two or more varieties of these gelatine films, nice results may be obtained.

In many establishments the mechanical films as they are termed are used almost exclusively on calendars, show-cards and label work. Many cigar and perfume labels, except for a little hand work in the darker shading colors, are made entirely by means of this apparatus.

We do not wish to convey the impression that the mechanical films are superior in artistic results or fineness of execution to the diamond point of the ruling machine, to the engraving needle, to fine stippling, or to the air brush, but for practical utility, clearness and sureness of printing results and technic, the gelatine films have a large place in the lithographic trade.

Great care should be taken in the keeping of the films clean and clear; no water should be allowed to touch them, as at that point they would swell and possibly break. The best way to cleanse them without injury is to wash them carefully with either turpentine or benzine, using a tooth brush to carefully cleanse the ink from between the dots or lines of the embossed design, and drying carefully with a soft linen rag; a cotton rag would answer, except that linen will not be as liable to catch on the rough design, and so cause smutting in the subsequent inking up.

A slab and roller used to ink up the film should always be kept covered with a suitable material. A

simple cover can be made from cardboard, and a more durable one from either wood or zinc. This will keep the dust from settling on the ink or roller, and so tend to decrease the annoyance caused by finding white specks in the work after having been rubbed down.

Drawing from Still Life, Casts, etc.—A step in advance from the work on the alphabet is the drawing of still life, etc., and then the drawing from casts, first in simple, then complex forms, and thence to the ideal and antique sculptures.

While the student may have no natural aptitude in this branch of work, the persevering and striving for attainment cannot but prove beneficial, while to the person of natural ability this will be but a step in the direction of artistic perfection.

Even the ability to draw the simplest forms can be utilized in the making of decorative design, many of the best designs owing much to their simplicity of execution. While this training is not expected to turn out a Michael Angelo, Rubens or Millet, still any talent which a person may possess may be made profitable, if developed.

CHAPTER IV.

Chalk Drawing on Stone.

IT will be observed that heretofore our work has been executed on polished stones and has been done in ink or line work. We now take up the more artistic branch of lithography, sometimes known as crayon work. By this means the expert artist on stone is enabled to reproduce the works of the great painters in a manner equal to the original conceptions, and they may be multiplied so cheaply that the most unpretentious cottage may be supplied with a copy of the life work of an artist painted to embellish a temple of worship or adorn the walls of a monarch's castle.

Instead of being polished, the surface of the stone is, for this kind of work, broken up into minute points, technically called "a grain," which, when drawn upon, receives the lithographic chalk in proportion to the pressure employed. This is called graining and is fully described in the chapter devoted to the preparation of the stone.

Crayon Drawing on Stone.—By this manner fine artistic results are achieved. By crayon in combination with pen and ink and stipple work, many of the colored lithographs now produced in the United States are executed. Its advantages are in the freedom with which the artist can work on the grained stone, which also permits

the super-imposition of various colors, blending them harmoniously when thus printed, without any apparent mechanical texture, allowing many varieties of tone to be produced from a few plates and printings.

In distinguishing this method from pen and ink work which is uniformly executed on a polished or smooth surface, the crayon manner is worked on a grained or roughened surface; this is produced by selecting a stone of good quality, free from chalk spots or veins, which is polished in the usual manner, and treated as follows:

French sand, flint sand or a finer grade of emery (according to the quality of grain required) are sifted evenly over the surface, using a sieve of not less than sixty meshes to the square inch, a sufficient quantity of water sprinkled over the sand and a small stone called the graining stone placed thereon, which is carefully worked in small circles completely over the surface of the stone to be grained; while performing this operation, the sand must be kept moderately wet, by sprinkling the surface, and the graining qualities of the sand maintained by fresh additions, the purpose required being an even and uniform texture to the whole stone.

A stone finished with comparatively fresh sand will be sharp and open grained, if finished with worn out or slushy sand, will be flat and shallow in grain, for all medium sized work, a grain which is sharp, clean and even without being deep, is best; when finished it should be regular and as clear on the edges as on the center of the stone. With practice, and by combining French and flint sands in different portions, grained surfaces for the purpose intended can readily be produced.

When finished, the stone should be thoroughly washed with running water, taking great care that all sand is removed, then tilted upon its side to drain and dry—the quality of the grain should then be tested by the artist, trying the corners with the flat side of a crayon, when if satisfactory, it is ready for the outline or offset to be placed thereon; this is done in the same manner as for engraving or ink work, and is then ready for working by the artist.

All the precautions in regard to moisture, humidity and cleanliness in the engraved manner apply to crayon drawing, and in addition, much trouble can be caused by dandruff from the hair falling on the stone. These fine scales are often imperceptible, yet being intensely greasy, are absorbed by the stone, will resist acid more than the crayon drawing and make their appearance in dark spots when the roller is used and so spoil what would otherwise be a creditable piece of work.

The crayons used for drawing are composed of similar ingredients as "tusche," are soft and brittle and must be sharpened from the point in the same manner as charcoal. They are made in five qualities—No. 1 is soft, No. 5 is hard—the variation in firmness is caused by the proportion of wax and soap in the soft crayon and the excess of shellac in the hard, they must be selected for the work in hand. Generally, where flat surfaces and shadows are to be drawn, No. 1 is most suitable, and where much detail is necessary, the hard crayon will be best suited. In small portrait work, No. 3 and No. 5 will give the best results. The graduations from the lightest tint to deep shadow will require careful working

up—a decided manner of working will give the clearest prints, and clear, clean graduation will only be produced by persistent painstaking practice. Those parts which are to print in full color are termed solids, and must be put in with tusche. Either pen or brush can be used for this purpose; the latter is preferable. All solids should be put in previous to drawing, as the pen would pick up the crayon. A little stippling with the pen is permissible to increase the depth of shadows, and upon the good judgment of the artist much will depend. In the treatment of the work for effect, few rigid rules can be laid down.

Upon inspection, tints which have been drawn too light, can be worked over with the crayon until the desired strength is attained, while parts that are too dark, must be picked down with a fine needle point, and in large work are sometimes reduced by ripping down with a knife or file. In using this method, a knife with a firm spring is held in the hand in a similar manner to a pencil, the cutting edge is drawn lightly (broadside on) towards the operator, the blade is thus caused to bounce at short intervals, making a minute regular cut at each bounce, it requires dexterity to accomplish this properly. This method is much used on large work on account of its quickness and the bright effects which it can produce.

Rub tints are generally combined with crayon work and are used for the lighter colors, such as yellow, pink, light blue and gray, in color work where this method is to be used, a heavy offset is required (the reason therefor will follow), a special block crayon is used for

rubbing in the tint, called rubbing ink. (It is softer than No. 1 crayon, having a greater proportion of wax and soap in its composition.) To apply the rubbing ink a piece of cheese cloth, or chamois leather, is tightly stretched over the forefinger, so that a perfectly smooth surface is presented on the fleshy part, this is then rubbed on the cake of rubbing ink and with an even, dexterous movement, applied to the grain of the stone. In working rub tints, the outline will often be overrun; fitting of the colors, and opening of high-lights, must be accomplished by scraping away the surplus parts with a flat scraper. The use of a heavy offset, is now apparent, as it will be seen through the rub tint whereas a faint offset would be obliterated.

Tracing the outline to stone will be the first operation. Proceed as instructed in Chapter II., but observe that the red tracing-paper must have but little color upon it, because the grained surface takes off a greater quantity than the polished stone. Try it first, and if too red wipe it off the paper with a dry cloth, until the necessary color is gained. It should be borne in mind that liquid ink will penetrate a strong line of the tracing, while the dry chalk might be kept from the stone by the interposition of the red chalk line; and hence the advisability of having the tracing very faint.

A tracing may also be made in soft red or black conté crayon. When this is put upon the stone and a piece of hard writing-paper laid upon it, it may be transferred to the stone by rubbing with some smooth hard substance, taking care that it does not shift.

Having got the subject traced to the stone, remove

the tracing-papers and substitute for them a piece of plain paper fastened round the edge of the stone. Tear a piece out of the upper left-hand corner and proceed to work there, removing the paper as necessary until the whole is completed. The *hand board* must be used to keep all pressure from the newly-deposited chalk, because if the chalk be partly removed from the surface it will have less power to withstand the action of the etching, and the result may be spots and patches of lighter color.

Lithographic chalks are pointed with the knife, like conté crayons, by laying the point on the left forefinger as a guide, and cutting *from* the point. It is unnecessary to use the knife every time the crayon requires pointing. As long as it remains nicely tapered, it may be brought to a good working point by rubbing it gently—turning it between the thumb and finger at the same time—on a piece of coarse printing-paper or other similar surface. This will give a better point, and more expeditiously, than the knife, and will usually be found to be less liable to break.

The outlining should be all complete before commencing to shade, or lay in the *"tinting."* If it is an architectural or other subject requiring fine detail, it may be put in with *copal chalk* with a firm touch, as it will then better resist the etching. This chalk is made as hard as possible consistent with the quality of rolling up, but is not so strong as No. 1, and should not be used at all for tinting, nor for outlining, when No. 1 will answer the purpose. No. 2 is softer and stronger, and may be used for bolder drawings and deeper shading; while No. 3 is to be reserved for very deep parts, or such subjects as large, bold portraits.

Where precision of outline is of more importance than artistic effect,—where it is more minute than the chalk point can well accomplish,—and where the nature of the subject permits or demands it,—ink may be used, either with brush or ruling-pen. It must be strong enough to permit of etching, and black enough to enable the artist to estimate his effect.

For the first tint take a light crayon-holder and No. 1 crayon; hold the porte-crayon, in a slanting direction, as far from the chalk as can conveniently be done, and lay in the tint with light and regular strokes, taking care not to commence or leave off heavily, as that would make it spotty. In this way cross and recross it until the desired effect is obtained.

Having completed the drawing with the crayon, little bits of pure black may be put in with ink to give effect where necessary; lights may be removed with the scraper; transparency given to the shadows by the judicious use of the needle-point; figures separated from the background by the same instrument; and many little things done that taste and experience may dictate, previously to the drawing being handed over to the printer to prove. In giving effect by means of ink, it should be applied with a brush, as it is possible that a pen may scratch the stone, so as to leave white marks in the impression.

If an error be committed of any large extent, the part must be grained out with dry sand and a muller proportioned to the surface to be removed. The sand must then be carefully and thoroughly brushed away, and finally wiped off with a perfectly clean dry soft cloth, until nothing remains to prevent the proper adhesion of the chalk subsequently to be applied.

Suppose the drawing finished, and a proof submitted to the inexperienced artist, his feelings on receiving it will be those, probably, of disappointment. He will perhaps find that his light tints have become more light; his dark shades too heavy and opaque; and the general keeping of the subject altered for the worse; the result being aggravated by the substitution of white paper for the pleasant neutral grey of the stone on which it was drawn. The remedy is obvious. The light tints, to stand an etching sufficient to keep the deep shades clear, must be drawn more strongly; the middle tints as desired; and the deep shades a trifle lighter than they are intended. Then, by printing the subject on a tint somewhat of the color of the stone, with the addition of white high lights, now at command, it is possible to produce an effect more in unison with the wishes and expectation of the artist.

A most important point in chalk lithography is to keep the point of the crayon proportionate to the tint sought. Fine points make fine tints, and coarse points coarse tints. If it be desired to produce a rough effect, as on old walls, roads, shingly beach, and such like, the point must be broad, and held at an acute angle to the stone; or a piece of broken chalk may be cut to a flat surface on its side, and rubbed in the direction required over the stone, on which it will produce a marvellously rough effect.

Care and cleanliness are essential here, as in other styles of lithography, and the artist should be cautious in permitting persons unacquainted with the art to examine his work during its execution, as he thereby runs

the risk of scurf from the hair, spittle-spots, and other similar accidents occurring to the stone.

Etching the Drawing.—This operation is usually performed by the foreman-printer. It is an intermediate process to be gone through before the stone is ready to be printed from, which is very important, as affecting, in a very marked degree, the good quality of the impressions; but as it does not essentially belong to printing, and might with advantage be done by the artist, it will be described in this place.

The term "etching," in lithography, is no doubt borrowed from the practice of etching on copper, but it is somewhat improperly applied. The etching process on copper consists in producing an effect by drawing with a point through a wax surface spread upon a metal plate, and afterwards fixing or deepening such work by "biting in" with dilute nitric acid. In lithography the term "etching" is applied only to the acidulation of the stone by dilute nitric or other acid, the effect of which is rather to make the work lighter than stronger, and is thus diametrically opposed to similar operations on metal.

When nitric and most other acids are brought into contact with the carbonate of lime, of which the lithographic stone principally consists, decomposition ensues; the nitric acid seizes upon the lime, and sets the carbonic acid free, which then passes off rapidly in minute bubbles, producing the phenomenon known as effervescence. The necessity for etching chalk drawings may be understood by studying the following conditions:

a. Lithographic crayon is soluble in water by reason of the soap it contains, and would spread under the operation

of damping the stone in printing, unless means were used to restrain it.

b. Soap is, from a chemical point of view, a combination of fatty acids with caustic alkalies, which latter render those fatty acids soluble in water.

c. When any mineral acid is brought into contact with the soap, it unites with its alkali, to the exclusion of the fatty acids, which then become again insoluble in water.

The lithographic chalk, being acidulated in the etching process, has its saponaceous character destroyed, and is rendered insoluble in water, and thereby prevented from spreading under the influence of the damping process.

Some good practical printers doubt the action of the etching on the alkali of the soap; but any person may try the experiment for himself in the following simple manner: Rub some of Korn's chalk in two places on a clean stone (a polished one will answer the purpose). Acidulate one with dilute acid sufficient to cause effervescence, but leave the other free. If a clean sponge and soft water be now taken, it will be found that the unetched chalk will be partially washed away, and become grey, while the other remains black and unmoved. Mr. M. Hanhart, in an article on "Chemical Printing" in Watt's "Chemical Dictionary," thus speaks of the probable nature of the etching and gumming processes:

"The action in this part of the process is somewhat obscure, but it is probable that the nitric acid dissolves the superficial particles of the stone, and the resulting solution forms with the gum an insoluble gummate or metagummate of calcium. One thing is certain, that the gum becomes firmly fixed on the stone, and cannot be removed even by repeated washing with water. The nitric acid also acts upon the chalk by laying hold of the alkali and setting the fatty acids free.

"The stone, thus prepared, is next washed with water, to dissolve off the excess of gum and the nitrates of sodium and calcium, and afterwards with oil of turpentine, which removes

the excess of grease from the drawing, and renders it nearly invisible. The fatty calcium salts formed by the action of the soap on the carbonate of calcium are, however, insoluble in the turpentine, and remain untouched; and on subsequently wetting the surface of the stone with water, and passing over it a roller covered with printing-ink, composed of linseed-oil and lampblack, the ink adheres to those parts of the surface where these fatty salts are situated, while the remaining portion, which has been acted on by the gum, does not take up the printing-ink, because the fatty acids of the linseed-oil are incapable of decomposing the compound of lime and gum with which those portions are covered, and mechanical adhesion is prevented by the film of water on the surface.

"This view of the lithographic process represents it as altogether depending on a series of chemical actions. It is, however, more commonly supposed that the fatty matter of the lithographic chalk simply adheres to, or is partly absorbed by, the porous surface of the limestone; that the parts thus penetrated readily take up the printing-ink, and that the adhesion of the ink to the other portions of the surface is prevented by the interposition of a film of water. But if this explanation were correct, a piece of alabaster, or sandstone, or porous earthenware, or any other stone capable of receiving a granular surface ought to be available for lithography as well as limestone; whereas it is well known that carbonate of calcium is the only kind of stone that will answer the purpose; moreover, the mechanical theory of lithography takes no account of the peculiar action of the gum, which appears to be an essential feature of the process."

Our own views are somewhat different from those of Mr. Hanhart, and are founded upon experience and experiments. Our object not being the discussion of obscure phenomena, but rather the production of a practical treatise, we will allow our readers an opportunity of forming their own opinions, when they have mastered the manipulative details in which we shall have the pleasure of instructing them.

In practical lithography there are two different ways of applying the acid; firstly, flooding the stone with acid diluted with plain water; and secondly, brushing it with acid diluted with gum-water.

First method.—Provide a shallow wooden or other suitable box, of at least the full width of the stone, and sufficiently water-tight to answer the purpose. Into this box put sufficient etching solution to completely flood the stone, which must be fixed over a trough, sink, or other convenient place, at an angle of about 45 deg. Now take the etching-box, place its edge so as nearly to touch the upper edge of the stone, and pour its contents over it, so as to make, as near as may be, an uniform wave from top to bottom. The stone should now be reversed, and the operation repeated, because the acid in descending will, of course, remain longer on the lower portion than on the upper; but if the stronger part of the drawing be at the bottom, keeping it in the one position may be better than reversing it.

Second method.—Gum the clean edge of the stone with weak gum-water, and allow it to dry. Set the stone level, but in such a manner as to be able to give it a rocking motion. Convert the surface into a kind of tray by means of some engravers' bordering-wax, and pour the dilute acid into it, and as the bubbles of gas arise, rock the stone to detach them from its surface.

In these two methods, as soon as the etching is completed and the water drained off, the stone is to be gummed by a soft sponge or brush, and allowed to dry, when it may be put into the hands of the printer for proving.

Third method.—This is, perhaps, the one most generally employed, and has been found to give good results in most cases; by it additional etching can be applied to any darker parts that require it; but in this respect it is

not so perfect as the method to be described in the fourth method. According as the drawing is composed of strong or delicate chalking, and the stone is of a hard or soft nature, the preparation is to consist of from 40 to 60 parts of gum-solution, of the consistency of linseed-oil, to one part of acid (nitric or muriatic). This is to be poured into a dish of convenient size, and well mixed. Now take a flat, soft brush, of not less than four inches in width, saturate it with the solution, and apply it to the stone in bold strokes from right to left, and left to right, until the stone is covered. Repeat the operation, and if there are dark parts requiring it, have ready a smaller brush to further etch them with the same solution. Now rinse off the etching-fluid, and gum in as before described, and dry. It is better thus to wash off the etching preparation, because all further action is stopped, which may not be the case if the gum and acid were allowed to stop on till dry.

Fourth method.—This is founded on the desirability that exists for etching the darker parts of a drawing more than the lighter, and if carried out by a man of experience, on a suitable subject, cannot fail to give satisfaction, though a little more troublesome. Prepare an etching preparation as for method one, suitable to the lightest tints, and with that etch the whole of the drawing. After drying, instead of gumming the whole, apply the gum to the lightest tints, and etch again in the same manner. Wash well with plain water, and dry. Now stop out with gum the light and middle tints, and etch for the third time. The etching, in each case being momentary, will not dissolve the gum, which, for the short period the acid

is on the stone, may be fully gummed and put aside to dry. It must be noted that subjects having a continuous gradation from light to dark cannot be etched on this principle.

While treating of the nature of acids and their uses in lithography, it may be desirable to notice another application of them—viz., to retouching and correcting after printing.

Etching Crayon Work.—This part of the process requires both experience and care, as an injudicious etching would entirely change the effect intended in the drawing. For all crayon drawings it is advisable to make fresh etching solution. Gum solution carefully strained through cheese-cloth and of the consistency of cream, to which two per cent. of nitric acid has been added and well mixed, should be tested on a clear part of the stone on which the drawing has been made. In etching crayon work, the strength of acid should be such that the lightest tint made by the artist can bear without injury. Experience is the best guide, for if the etch is not strong enough, the work will roll up heavily, and have a thick and foggy appearance, while if the etch is too strong the fine tints will have suffered and be weak and rotten if they do not disappear entirely.

When the etch is tried on stone, it should show a slight effervescence in from three to four seconds. When dry, the surface gum should be washed off with clear water, using a well saturated, clean, soft sponge for that purpose. The crayon may now be washed away while the stone is damp, by a soft rag on which sufficient turpentine has been sprinkled, the rag charged slightly with

printing ink from the slab, a few drops of water sprinkled on stone, the design lightly charged with ink from the rag, and then firmly rolled up with a good freshly scraped roller very slightly charged with good crayon black ink, when properly done, the drawing on stone should show the same delicate tints, shading and tones as when finished by the artist, to whom it should now be submitted. When stone is passed by the artist, the drawing is protected by dusting with finely powdered rosin, which can be followed by an additional dusting of soapstone powder, the second etching for printing purposes is now applied. After gum has dried, stone may be handled in the usual manner, great care being taken never to use any more ink than is sufficient to produce clean, clear impressions. When a satisfactory proof has been obtained it should be O. K'd and kept as a guide or standard for all subsequent impressions.

Use of Black Impressions in Color Work.—When finished proving a crayon drawing, if printed in color, should be washed out, inked up in a good grade of crayon black ink, and a good proof made, which should be marked with name of color printed, its sequence in the printing operations and the number of the stone on which it was drawn. This proof will serve as a guide to the transferrer in the location of the original and as a guide to compare with his transfer impressions, which must also be in black. After this black impression has been made, the drawing should be sharply inked up, dried and carefully dusted with finely powdered rosin. Stone should now be washed off with clean water, dried, and carefully gummed in, the gum should be carefully smoothed, using a soft, dry rag for that purpose.

Retouching and correcting after printing on grained stones may be effected according to the instructions given for polished stones under the heading Corrections and Additions after Rolling Up (page 40). If done with every care, and the additions made with No. 2 chalk, they may be expected to stand very well, though they will not equal in strength and firmness the original drawing.

CHAPTER V.

Taking Impressions for Transferring.

STONES, after the *Etching*, described in the last chapter, are ready for the press. As we have, however, given instructions for drawing in two styles on *paper*—with pen and brush (line work) and with chalk (grained paper), we must show how they are to be put upon the stone previous to printing from them, or in the language of the trade, transferring them. The transferring method applies not only to work executed in the first instance by hand labor, but also to the reproduction by lithography of engraved plates, blocks and type. We shall, therefore, take this subject next in order, and devote a chapter to it.

One of the most important qualifications for the foreman of a small lithographic printing-office is the ability to pull transfers from copper-plate.

The copper-plate press may be used for pulling the transfers, but the litho press will be found quite sufficient. It is as well to devote a small press entirely to this purpose, and have conveniences at hand for use at any time. A small lithographic press will cost less money than a copper-plate press, and may be used for litho work as well in a small establishment.

An apparatus for warming the plate will be necessary. It may be simply held over an ordinary gas flame, but this is a mode to be avoided by any one who wishes to

do his work neatly and cleanly, because it smokes the back of the plate and causes it to accumulate little hard spots of ink-like nature that soon develop into convex spots upon the surface of the plate.

A jigger is a kind of light wood box open at the ends, to be placed near the heaters. It is used for laying the plate upon while it is being wiped, the open part underneath serving as a receptacle for "whiting," which it thus preserved from dust and grit. This apparatus, though useful, is by no means indispensable.

Printers' blanketing is used for laying upon the plate, over the transfer paper, while the impression is being taken, serving by its elasticity to drive the paper into the lines of the engraving. Good flannel, such as is used for underclothing, if employed double or treble, will answer the purpose admirably.

The damp book is usually employed, when much transferring is done, for preparing the paper previously to taking the impression, and also preparatory to laying it down upon the stone. It consists merely of 20 to 30 loose sheets of thick printing-paper, of a convenient size, wetted by dipping every alternate sheet, and then putting them in a heap under a weight until equally damp all through. It must not be used until the water is equally diffused through the whole. To prevent the mildew, to which it is subject, a little carbolic acid may be added to the damping water.

Though recognizing the great convenience of this arrangement, and fully acknowledging the perfection with which a transfer may be *damped for the stone,* we do not consider it equally applicable in damping the transfer-

paper previous to pulling the impression, for the reasons following:

a. The composition on the paper is made adhesive, so as to attach it firmly to the stone during the operation of transferring; and the damping-book acts admirably in bringing the paper into such condition by acting upon the composition and softening it.

b. In taking the impression from the plate, it is desirable that the composition should adhere sufficiently to prevent its shifting, but not so strongly as to leave it partly on the plate when the transfer is being lifted.

c. If the transfer-paper is damped upon the back with a sponge containing but little water, the paper may be rendered sufficiently supple and yielding as to easily penetrate the lines of the engraving at the same time that it adheres well enough to the surface of the plate without sticking too strongly.

For these reasons it is advisable either to damp the paper on the back with a sponge containing a little water, or to place a piece of clean, dry paper in the book on the face of the transfer paper, to prevent its becoming too adherent when applied to the plate.

Taking the Impression from Plates.—Tie up a piece of transfer-ink in sufficient old linen or silk to cover it. This acts as a strainer during the inking of the plate. Warm the plate until it can barely be held in the hand, holding it by a piece of folded paper or cloth to protect the fingers. Rub the covered-up stick of ink upon the plate, until sufficient is melted to cover it, continuing to rub the ink into the lines of the plate, and warm it as found necessary.

When it is well filled in, take a piece of soft rag, fold it over the fingers, and wipe the superfluous ink off the still hot plate, endeavoring in so doing not to wipe the ink out of the lines, which is best done by wiping *across* them.

Shift the rag to a cleaner place, and wipe again until all the ink is removed from the surface and the plate looks clean. Now carefully examine it, and see if any ink remains in small specks, which will very likely happen. If so, remove them with the finger nail or a splint of wood. When quite free from surface ink, rub the hand on a piece of whiting or soft chalk, and then wipe it over the other hand, or similar surface, so as to get a little only on it, and with it polish the plate, thus removing the last trace of grease from the surface. Be careful to have but little whiting on the hand, or it may stick to the ink in the lines, in quantity sufficient to prevent its adhesion to the paper.

Place a small thick stone in the press, and upon it the plate face upwards. Upon the plate put a piece of transfer-paper prepared side downwards, and previously damped, and over that the flannel or blanket; turn down the tympan, and by depressing the lever bring the scraper down upon the tympan just over one end of the plate, and with a good pressure run the plate through by the handle. It is an excellent plan to have two pieces of millboard of the thickness of the plate—one on each side of it—as the scraper may be then set on the millboard, and a proper pull got all over the plate.

Now raise the lever, pull out the carriage, lift the tympan, reverse the plate in the press, and repeat the operation. This should now be sufficient, but occasionally it may have to be repeated twice or thrice. Take the plate from the press, and remove the flannel, when the cutting in the plate should show plainly at the back, if sufficient pressure has been applied. The transfer must

not now be peeled from the plate for two reasons: (*a*) the ink being cold and hard, will not readily quit the lines; (*b*) the composition is damp, rotten, and deficient in tenacity. To bring all into proper condition, the plate must be gently warmed to soften the ink and dry the paper, which will then contract, and leave the plate with very little assistance.

The impression should now present the appearance of glazed enamel paper, with every line full of ink—distinct and sharp.

If the impression is very full of ink, or the ink be too soft, so that there is reason to anticipate its spreading in transferring, it may be laid upon a piece of *clean printing* paper, and pulled through the press, when some of the ink will adhere to the clean paper. To separate, it will be safest to warm them slightly.

Retransfers from Stone.—A small litho roller should be kept for this purpose, because it will then be always ready, while an ordinary printing-roller would require scraping both before and after using the retransfer ink upon it. This is rendered necessary by reason of the soapy nature of the ink making it unfit for ordinary printing. An ink which may be used without injuring a drawing in taking a few transfers, might spoil it when employed in printing a quantity. The non-drying nature of this ink will be found to keep the roller soft and pliant for use, with an occasional scraping previous to applying new ink, and this furnishes an additional reason for appropriating a roller to this use alone.

Take some of the transfer paper, sparingly damp the back with a sponge. Wipe off the superfluous water

with a cloth, and in a few seconds the paper will lie flat, when it is ready to take an impression from the stone without sticking sufficiently to break the composition in lifting. It is now only required to roll in the work, waft the stone quite dry, and to pull the impression on the previously-damped paper. It will be found to adhere strongly to the stone, and must be raised carefully at the edges, and peeled off.

Transfers from Type and Woodcuts are very useful, and in some offices have a wide application. The inspection of some commercial samples will show the student how they may be applied. It will here be sufficient to point out that it is no unfrequent thing to find letterpress invoice headings, etc., transferred to stone, and printed at machine. The advantages are that transferring is quicker than stereotyping; that four to eight may be printed upon a sheet; and that no impression is made to show upon the back.

The paper is to be less damp than in the last two methods; the ink to be used with a letterpress roller, and a fine card to be laid upon the back to get a nice, sharp, clear impression. If the ink is not at hand, and the transfer is wanted quickly, it may be printed in ordinary stiff letterpress ink, which, containing soap, is of the nature of a transfer ink.

The fact that all the modes described in the preceding paragraphs may be employed in one piece of work, united with any of the modes of drawing or writing herein previously explained, shows that a power is possessed by lithography that can be found in no other mode of printing, for, in fact, it may successfully imitate the other two, while it possesses advantages peculiarly its own.

Condition of the Stone.—The stone for the reception of transfers should be polished free from perceptible scratches, perfectly clean, and free from gum, grease or dust. This latter cannot be easily seen by inspection, but may readily be detected by wiping the stone with a piece of dark-colored cloth, velvet, etc., when the dust is visible on the stuff used.

The stone must have been dried, but its temperature may vary according to circumstances. For ordinary work, it is perhaps safest to have the stone slightly warm, but it is undeniable that transfers can successfully be made on cold stones, and even on damp ones, when, from the nature of the work, it is desirable to use them.

The qualities of the transfer-paper will sometimes determine whether the stone is to be used warm, for there are papers that will not adhere to cold stones. Such are those made of parchment size, or other varieties of hard gelatine, which do not become adhesive unless warmed to some extent, though they will absorb water at a low temperature.

CHAPTER VI.

Methods of Transferring.

THE manner of taking impressions suitable for transferring having been described in the preceding chapter, we proceed now to show the manner of putting them down upon the stone, so that they may be printed from. There are three distinct methods of transferring, each having its own special advantages.

First. Transferring damped transfers to dry stone, either warm or cold.

Second. Dry transfers to wet stone; and

Third. Damped transfers to wet stone.

Transferring to Dry Stone is the mode usually, and in some offices invariably, adopted. The stone may be warm or cold, but in all cases must be thoroughly dry. If the drawing, writing, copper transfer, or other work, is of an unusually fine character, or if the ink used is of a very hard nature, the stone may be warmed with advantage; but it should not be made hot, or the transfer-ink may spread, as it can hardly be expected but that some part of the work will contain heavy lines, which would, of course, be more liable to spread than finer ones.

The damping of the transfer-paper requires care and experience. It has before been stated that the object is to render the composition sufficiently adhesive to stick to the stone under pressure, and this may be ascertained by

taking a corner of the paper containing no work, and squeezing it between the finger and thumb, to which, if it attaches itself by the composition, the transfer is ready for the stone. Care must be taken that the thumb and finger are not damp or the transferrer may be thereby deceived. A very convenient substitute for a damping-book is a piece of thick linen cloth dipped in water, wrung as dry as possible with the hands, and then opened out and taken by the corners, and well shaken with a jerking motion to straighten it. This is then folded, and used to put the paper between. If the coating on the transfer-paper is very soft, a piece of thin plain paper should be put upon the face of the transfer to prevent it absorbing the damp too readily.

The stone and transfer being ready, the latter is to be laid down upon the former, and where it is a plain, single job, such as a circular, it may easily enough be laid in its place; but as it frequently happens that the transfer has to be laid very accurately to a mark, and that it will not do to shift it about upon the stone to adjust it, it is desirable to handle it in the manner following: Take a piece of clean, rather stiff paper, and lay the transfer upon its upper left-hand corner, so that about half an inch shall hang over the paper. This, being held in the right hand, can be readily accommodated to any point upon the stone without soiling it; when in position, place the finger and thumb of the left hand upon the projecting edge of the transfer, and press it to the stone while the plain paper is being withdrawn, after which the left hand can be taken away and the transfer left *in situ*.

If several transfers have to be laid upon a stone that

is warm enough to dry them quickly, they must be pulled through the press singly or in rows of two or three, according to the quickness of the workman, for if all were laid before pulling through, some would be dry, and would not adhere.

Now that the transfers are laid upon the stone, lay over them a piece of clean printing paper, and over that a piece of printer's fine blanket; pull them through once with a moderate pressure, and increase it a little afterward until, say, the third pull. Now take off the backing, reverse the scraper in its box, shift the stone a little in the press (to overcome any slight defect that may exist in the tympan or backing), sponge the back of the transfer, and pull through again.

The composition may now be washed off, and the stone gummed and allowed to dry.

The student's attention is requested to the great importance of a level stone and level scraper; when these co-exist much less pressure is required to make a successful transfer, and the risk of spreading the lines is much reduced. When the transfer is very large, and the evenness of the stone cannot be relied upon, strips of cardboard or folded paper may be applied to different parts of the stone in succession, both longitudinally and transversely, so as to be sure of applying sufficient pressure to every part.

Independently of getting a true surface, large transfers present a difficulty in their liability to *slur,* by the ink touching the stone when laid down, and shifting afterwards by the stretching of the paper, thus making two marks instead of one.

The transferring of the autographic transfers comes within this class, and is usually performed as follows: The paper is sponged at the back with weak solution of nitric acid in water, laid upon the warm stone, and passed once through the press under heavy pressure; or the back of the paper may be floated upon the acid solution, taking care not to wet the front, and hung up to dry. To transfer, damp the back with plain water and proceed as before described. A convenient way of floating will be to put a quantity of acid solution on a piece of clean, level glass; lay one corner of the paper upon it, and push the rest of the paper down gradually.

Transferring to a Wet Stone can only be successfully accomplished with a transfer paper that is readily rendered adhesive by cold water. Such paper may be coated with any of the varieties of starch or common glue, mixed or not with gum arabic; but transfer paper made with the harder and purer varieties of gelatine does not answer the purpose, though a little may be added to the starch paste to improve its quality.

The advantages of laying down a dry transfer on a wet stone, when it can be successfully done, are many and great. It is easier to damp the stone than the paper; it is quicker. Patched transfers can be put down without creasing them, and all can be transferred without altered dimensions.

Everything is to be prepared as for the mode of transferring last mentioned; but instead of damping the paper the stone is to be made wet with a perfectly clean sponge, linen rag, or wash leather, the latter being preferred because it leaves less loose material from its surface upon

the stone. The quantity of water to be left upon the stone must be determined by experience, but it may be sufficient to say that no more is required than will unite with the composition and cause it to adhere to the stone. Thus, a plate transfer paper would take up more water than a writing transfer paper. If the stone be wetted to about the same degree as is required in printing, the water will be found in about the right quantity.

The stone being ready, the transfer is laid upon it as in the first process, and as quickly as possible passed through the press under proper pressure, about three times over. By this time the stone should be dry, which may be ascertained by lifting a corner; if not dry let it remain uncovered until it is so. If the stone is dry, it may be assumed that there is no impediment to its union with the ink, and the back of the mounting paper may be wetted until the gum is soft enough to allow it to be lifted, leaving the transfers upon the stone.

The transfer may now be considered to be in the same condition as after the first pulls in the last process, and may be damped, etc., and finished in the same manner, the transfer paper allowing of the subsequent damping without blistering, if the process has been successful.

Transferring by Damping the Transfer and Wetting the Stone may be resorted to with great advantage when the transfers are very large, and more especially so tracings on transfer paper. These latter are very difficult to damp properly, because the varnish by which the paper is rendered transparent fills up the pores of the paper and prevents the entry of the water for a long time in damping the back of the transfer, both before and

after it has been subjected to pressure; while if it be put into a damp book or cloth the probability is that the composition will either be too damp or not damp enough. If it becomes too damp, two results will follow in laying it down on the dry stone:

a. If the composition touch with stone in a place where a line or other inkmark subsequently falls, it will prevent its adherence to the stone.

b. If a line first touches the stone, and afterwards shifts, it will attach itself by mere contact to the stone in the first instance, because the composition has become so soft; and when the job is transferred, the line will probably present a broken appearance, thus: ——— ——— ———, instead of being continuous, as intended by the draughtsman. Now, if the transfer be damped upon the back, so as to render it limp before the composition is softened, the transfer may be shifted considerably on the stone without injury; and if the stone be wetted to make it adhere, the conditions of success will have been, in a great measure, complied with. After sufficient pressure has been applied, it should be allowed to dry on the stone (which takes a little longer when this process is used), and then treated as for transferring to dry stone.

It may here be pointed out that in the dry stone process described, the dry stone absorbs the damp from the transfer, while in the wet stone method the transfer absorbs much of it from the stone; but in the way just treated of, both being damped, the one has no chance of correcting the other, and must be permitted to dry before being taken off the stone.

CHAPTER VII.

Lithography on Paper; or Transfer Lithography.

FORMER chapters will have placed the student in possession of the theory regulating the employment of lithographic stones as well as the art of preparing them for printing. He has also been shown the uses and nature of transfer-paper, and the materials for writing and drawing upon it. He is now ready to commence the actual practice of lithography.

As the latter is a very comprehensive and complicated subject, it may be well to take it up at that part which offers fewest obstacles to the beginner. For this reason we begin with Lithography on Transfer-Paper. Prepare the ink as described in Chapter III, "Ink Drawing on Stone."

Ink for Law Writing, when much is used, may be conveniently mixed in larger quantities, and ought to keep well for a month after preparation. It is usually used with ordinary fine-point steel pens depositing a good quantity of ink, which latter consequently may be made much thinner than is usual with other styles of work. Take a piece of stick ink and cut it into fine shavings; put it into a small clean saucepan, cover it with distilled or filtered rain-water, make it simmer over a fire until dissolved, and then add more water until brought to such a condition that it will flow quite freely from the

pen when used with rapidity. Cork it up in a bottle, and use it as wanted from small ink-pots, to economize.

The transfer-paper is supplied ready ruled for use to the law-writer, who has simply to attend to the following rules:

First—Write upon a pad of blotting-paper, but never use it to blot off the writing.

Second—Be careful to use a piece of clean paper under the hand when writing, and scrupulously avoid handling the paper or even touching it with the fingers, except at the edges where no writing is to occur. Finger marks from a moist or greasy hand roll up black.

Third—Corrections may be made, if small, by removing the ink with india-rubber or ink-eraser, or, if large, by washing it out with clean spirits of turpentine or benzoline. In either case it must be taken out without leaving any of the previous ink, or the whole intended correction may roll up black. Sometimes it may be better to paste (using as little as possible) a clean piece of transfer-paper over the part to be corrected, but gum must not be used.

Fourth—If the paper works greasily, rub it with powdered whiting or chalk, or wash it clean with spirits of turpentine or benzoline, or rub it well with clean india-rubber.

Sheets of Quantities, for architects and engineers, in addition to the cross lines for writing upon, have *down lines* identical with the down lines of the sheet upon which they are to be printed. They should be ruled by the machine-ruler at the same time as the transfer-paper is ruled, and kept in stock. When the transfer

is laid down, the place of its margin is marked with the lead upon the stone, and a correct "lay" thus made for the sheet to be printed.

In writing "old English" or "German text," take either a quill or steel pen, and form a nib of nearly the width of the letter required; with this make all the thick strokes, with very little ink in the pen, taking it up as often as required, being careful not to deposit upon the paper sufficient ink to spread, nor so little as not to transfer properly. When the thick strokes are dry, the thin ones may be put in with a fine pen. It is usual in practice to carry all the writing forward and slightly pencil the words for "texting," which is then done afterwards. It may be useful to point out that in making pens for these broad strokes, the smaller the cylinder of which the pen forms a part, the less liable is the ink to be deposited on the paper in inconveniently large quantities.

Copperplate Style and Fine Ornamental Writing is executed in a more careful and methodical manner on a finer and *thinner* paper. The learner will require very fine pens, the points, if steel, being so sharp that they will hitch in the paper in making the upstroke if it is laid on a flat surface in the ordinary way. This is to be avoided, in using both the steel and quill pens, by placing the left hand underneath the top edge of the paper so as to raise it from the table, the strokes may then be made on the yielding surface of the thin transfer-paper much more delicately and safely than when the paper is resting on the pad. Although this method will be found difficult at first, it is necessary to be accomplished

to become a transfer-writer. The letters must be made as carefully and slowly as may be found necessary to produce the forms required. Lines in pencil may be ruled all over the paper at about an angle of 40 degrees with the perpendicular, to keep to the correct slope; and double lines to write between to get the letters all one size; and if a middle line be added, a good guide will be obtained for the tops and tails of the letters.

When a Drawing has to be made with Instruments or the Lithographic Brush a stouter paper is better to work upon, and is best for use when strained in the following manner:

Sponge the back with water in proportion to the thickness of the paper, sparingly if thin; let it lie a few minutes for the water to be absorbed, gum or paste it round the edges, and attach it to a smooth drawing-board; take a piece of plain stout paper, wet it well until pliable, and lay it upon the transfer-paper, folding back the edges so as to leave the pasted edge free. The side in contact with the transfer-paper should not be wet.

The following points must be carefully attended to:

First—All lines are to print quite black, and consequently

Second—No attempt must be made to get effect by using pale ink.

Third—Thick ink will spread in transferring, and must therefore not be used in producing deep shades by lines lying close to each other.

Fourth—Thin lines with very pale ink will probably fail altogether.

Fifth—The ink being dissolved in water, the latter has a tendency to soften the composition on the transfer-paper; it therefore becomes necessary not to go over, with the pen, the same place twice while the ink is wet, or the result may be that the composition will become mixed with the ink and destroy its qualities.

Transfer Tracing Paper may be used most conveniently in the same way. When all the outlining has been done upon it, a cut may be made down one edge and a piece of white paper slipped between it and the original, so that the shading may be done without the interference of the shading of the pattern.

Chalk-Transfer Paper is a revival of an old process known almost as long as Lithography itself, and it possesses peculiar advantages. The etched stippled plate produces a series of points which rise to the same height from the body of the paper, and are so close to each other that the point of the crayon cannot penetrate between them, while the sand-grain consists of pyramids or cones of varying size and height. The practical difference is that in drawing on the paper grained by the stippled plate there are no intermediate lower dots to receive the chalk when more pressure is applied to deposit a greater quantity, and the work is consequently more open and better fit for transferring and printing from than the sand-grain, in which such favorable conditions cannot exist. For the same reason a harder chalk, such as copal, can be used for this kind of paper, while for the ordinary grain Lemercier's No. 2 will be found better. Nevertheless, the stippled plate, by its mechanical mode of production, produces a kind of pattern that is objectionable to the practiced eye, which, added to its high price, has given an impetus to the use of paper prepared by the older method.

Grained paper is eminently suited to the purpose of the amateur by reason of its extreme portability as compared with stone, and not requiring the drawing re-

versed as regards right and left. This latter quality will recommend it to the artist for the production of drawing copies, because he can then set before the student a pattern that does not appear in the disposition of its shading and foliage touches to have been produced with the left hand, which is often the case with those drawn direct upon stone.

Facsimiles of writing are produced by placing a piece of tracing transfer-paper over the manuscript to be copied, and carefully going over the whole with a pen or brush. If required for mere commercial work, less care may be bestowed upon it—unless the customer is unusually fastidious—than for purposes required for courts of law and copies of curious or old manuscripts.

Autography is a term applicable to all kinds of writing upon transfer-paper, but usually restricted to writing upon plain hard-sized writing-paper, with a strong lithographic ink. This process, though yielding fair results, is yet inferior to writing upon transfer-paper, because only part, instead of the whole of the ink, is left upon the stone in transferring.

CHAPTER VIII.

Proving, Rolling Up and Printing.

FOLLOWING up what has been explained in previous chapters, we are ready to enter upon the actual printing of drawings and writings on lithographic stones.

Treatment of Transfers previous to Printing.—This includes the "proving" of the work: by which is meant the "rolling up," cleaning, etching, and taking the first impressions to be submitted to the customer; and the instructions equally apply to drawings or writings executed direct upon the stone.

Suppose the drawing to be composed of very fine lines, the printer may have some doubt as to all the details being firm upon the stone if rolled up in the ordinary way. He may then take, in a sponge, some gum-water (free from acid) of the consistency of oil, and pass it over the entire drawing, using the left hand, while in his right he has a pad of soft rag charged with a mixture of turpentine, thin printing ink, and stone re-transfer ink, which may be rubbed over the drawing upon the still wet gum-water, with a circular motion, recharging the pad with ink and the sponge with gum-water as often as necessary. This should develop every line of the drawing, and render it quite black. By keeping sufficient gum upon the stone there is little fear of

injuring the drawing, though it will make the stone very dirty in appearance by reason of the mixture of ink and gum; this, however, may be removed by a wash of clean water, and the stone gummed in with clean gum and set aside for the ink to penetrate. In this operation the stone may be warm but of course it must be set aside after this treatment to cool.

If there be any idea that the transfer is weak, and if the *stone is cold,* it may be rolled up with the roller previous to gumming it, but this must be done *cautiously,* because the ink will, in the absence of gum, attach itself to the slightest grease upon the stone. It is also very apt to cause the lines to spread, and is to be recommended only in cases when the work is wanted quickly and almost anything will pass muster; such as the cheaper kinds of law work.

The common and best way for the ordinary run of work is to gum the stone, after the transfer is made, with fresh gum; allow it to dry, wash off with clean water, and roll up carefully with ink of medium strength.

Whichever method may have been adopted, the dirt will have made its appearance, and must be removed. This may be done by the conjunctive employment of the following methods:

First.—Clean the edges and other parts of the stone where there is no work with a water-sponge and piece of snake or pumice-stone, using a small pencil of the same to get between the lines. The principal part of the dirt may thus be taken away; but as there will most probably be specks among the work that cannot be got at with the snake-stone pencil, use the acid "stump" as now to be described.

Second.—Having a water-sponge in the left hand, dip the acid stump* into the gum and acid, and try it upon the edge of the stone, when it will be found to effervesce energetically if strong enough. This will also reduce the quantity on the stump, which may now be applied to the speck to be removed, rubbing it with the wood point. If any acid be observed to spread in dangerous proximity to other lines, the water or gum-sponge must be quickly used to wipe it off.

Third.—The finishing touches of cleaning between very close work, reducing the thickness of lines, &c., must be done with a sharp scraper, such as a mezzotint-scraper, or a penknife. †

The work having been cleaned, must now be rolled up again cleanly, but strongly; and etched in the following simple manner:

Have ready a small basin or other convenient vessel, containing acid and water of about the strength of lemon-juice, or of such strength as to effervesce gently when applied to the stone. Now, with a soft sponge charged with this dilute acid, go regularly and quickly all over

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* *Acid Stumps* are small pointed pieces of box or other hard wood, to be kept at hand and used with strong acid or (better still) gum and acid, for removing any specks of dirt from the stone. Taking these in the right hand, a water or gum sponge is held in the left to wash away instantly the acid when it has removed the dirt.

† Mezzotint is applied to a process of engraving, so called because it was at first supposed to require a large amount of middle tint or half-tone in the distribution of masses of light and shade. The ground is scraped away to the various degrees of lightness required. Mezzotint scrapers are useful for correcting work upon stone either for the use of the artist or printer; but in default of possessing one, a penknife or the ordinary erasing-knife may be employed.

the stone with a light hand, and again over the edges and other bare parts. After this gum in and allow to dry.

When the work consists of narrow surfaces like lines and dots, the etching-water, if used in moderate quantity, is thrown off again as soon as the sponge has passed over, by reason of the greasiness of the work. But if the work contains any broad surfaces of solid black, more care must be taken, because the repelling power of the ink will not be strong enough to throw off the acidulated water, which, standing in patches on such surface, will be likely to find its way through the ink to the stone, and cause a gray appearance when printed. By using powdered rosin as next described, this difficulty will be overcome.

If the work is to be printed at machine, or to go into the hands of an inexperienced youth to be printed, it may be treated with powdered rosin.† Roll up in rather thin ink: dust over the rosin when the stone is dry; wipe off what is superfluous with water-sponge, and repeat the operation. Set it aside for a short time for the ink and rosin to incorporate, when, on taking it up again, it will probably allow of another dusting without rolling up.

The stone may now be acidulated freely without fear of injury; either the strength of the acid being increased, or the application several times renewed. The acid is

† Rosin is the residue left over in the distillation of turpentine. It is an exceptional resistant for acid, and when finely powdered and dusted on to the work it is practically impossible for the regular etching solution to injure the grease or design part; should the rosin not be finely powdered, the acid will find its way between the coarse particles and thus give a burnt or rotten appearance to the work.

best used with gum and applied with a broad flat brush, if considerable relief is desired, but for ordinary work the sponge and ordinary etching-water will be sufficient.

The stone having been gummed, the ink and rosin are now to be washed off with rag and "turps," or a mixture of two parts spirits of turpentine, and one part olive oil, which should be kept for washing out drawings when necessary, and spirits of turpentine should always be at hand. It should be again rolled up, gummed, and set aside to dry.

It is desirable, whenever there is time and opportunity, to allow some hours or even days, to intervene between the getting ready or proving of the stone, and beginning to print; though when work is wanted immediately it may be put in hand at once.

Marking the Stone for laying down Transfers, &c.— Before proceeding to lay down the transfers, it should be ascertained whether they are to be printed on the whole sheet or on some part of it. If the job to be printed is to run a small number only, it may be transferred to any convenient part of the stone, because one at a time will be all that will be found necessary to print; while if a large number is required, resort will be had to multiplication by transferring, and care must be taken to put the transfers properly in position on the stone. Let an example be taken.

For instance, a hundred 8vo. one-page circulars, with fly-leaf. These may be printed on quarter-sheets of paper and then sent to the stationer to fold and cut; but as he cannot well do it without causing them to set off in the cutting, they may be printed upon ready-

folded 8vo. paper. Take the necessary quantity of paper section by section, open it, and "break its back," so that it may lie flat and open. Lay it inner side uppermost. Lay the next section *across* it in the same manner, and so on, to make a heap, in which each section is distinct from another by the long way of one being set *across* the short way of the other. Now lay the top sheet with its under side upon the stone, and when taken off, place the printed side up. When the section is printed and thus laid, as soon as it is complete, it may be easily refolded in the same manner as it was at first, and in like manner the rest may be printed.

This method will answer for any single page, or for first and fourth, or second and third; but when first and second or first and third pages are required to be printed, they are managed differently.

Let it be required to print first and second pages.

(*a*). Transfer first page to the right and second page to the left, so that an inch more space is left between them than if they were intended for second and third: or,

(*b*). Transfer the pages one above the other, with space enough to prevent the paper overlapping. To start printing, lay a piece of waste paper over page 2 and the *first* side of the note-paper over page 1, in proper position and pull impression; now lay *second* side of printed sheet on page 2, and the *first* side of a clean sheet over page 1; cover the printed side (which now lies uppermost on the stone) with a piece of tissue-paper and pull through the press, when one will be completed and the other half-done. By continuing this method the

whole may be completed and printed on both sides in as many pulls as there are sheets to be printed, plus two. They may also be printed first on one side only, and then completed by printing the second side. In this case, during the second printing, two printed sides will be uppermost upon the stone, and a larger sheet of tissue must be used, so as to cover both. In each case the quantity of tissue paper required is the same.

To print first and third pages, transfer

(*a*) First page to left hand and third to the right, leaving no extra space, but exactly as if first and fourth were to be printed; or

(*b*) First to right, third to left, leaving no extra space; or

(*c*) Transfer one above the other. *To print,*

(*a*) Lay third page down and then first with fourth page overlapping fourth.

(*b*). First, lay page 1 and next page 3, when page 2 will fall on page 2. The tissue-paper is to be used as before.

Printing.—In the last few paragraphs it has been necessary, to avoid complexity of description, to assume that the student knows how to use the printing-roller, damping-cloth, &c.; but as that was an assumption only, it is proposed now to deal more fully with this highly important subject.

Let it be now supposed that the student has placed at his disposal a piece of work on stone that is in proper condition for printing, and that he desires to take impressions therefrom. He will require a roller, ink, palette-knife, sponge, damping-cloth, and a basin of water.

As he is supposed to be as yet unacquainted with the process, he must not begin at once to work, because the stone is not in working condition. The first thing to be attended to is its temperature. If it is warm, the gum may be washed off its surface, and it may be put to soak for an hour in cold water; or it may be set aside in any cold place as long as convenient; the object being to equalize the temperature of the stone to that of the printing-room. If the stone has been put into a cold, dry place, the first thing to be done will be to saturate its surface with cold water. This may readily be done by washing off the gum with a sponge and water leaving a pool of water upon its surface, and laying a sheet of paper on it. The paper will keep the water from running off or drying in patches, while it is soaking into the stone. The damping-cloth may be used for the same purpose, but after being a short time in use it usually so full of holes that it would answer the purpose only imperfectly.

While the stone is absorbing water, the ink may be prepared for printing. It has been mentioned that the printing ink, as bought from the manufacturer, is much too thick for use; in fact, the ordinary palette-knife is hardly strong enough to remove it from the can, and a short stiff one should be used for that purpose, if at hand. If the weather is cold, and the ink stiff, a thin, flexible knife is very likely to be broken, if used for its removal.

Before the printing can be proceeded with, some of this ink must be reduced with varnish to a thinner condition. Though the printer is not called upon to make

his own black ink, yet he has frequently to produce his colored inks. To do this he takes a small quantity of medium or medium and thin varnish, and rubs as much color as he can into it with his palette-knife; and then with the muller he grinds it upon the slab. After it has been thus spread over the slab, he gathers it up with the knife, and adds more color. By repeating this operation frequently, the ink gradually becomes stiffer, till no more can be added with the knife, and the color has to be added by dropping a varnish with rosin (as is done with varnish for letter-press ink), instead of producing the viscidity by burning only.

As varnish is an article manufactured on a large scale, there is no difficulty in purchasing it of a quality to answer the lithographer's purpose. It is made of several degrees of strength, known in the trade by the terms *thin, tinting, medium,* and *thick.* The more transparent and free from color it is, the better it answer the purpose of Chromo-lithography, as frequently the ink, in this style of printing, is only varnish, stained, as it were, with a little color or pigment. If this is light or delicate, it is essential to have the varnish as colorless as possible.

It may not be inopportune at this point to introduce a chapter devoted entirely to inks, as many references are made thereto in subsequent pages.

CHAPTER IX.

Inks, Varnishers and Dryers.

BLACK Printing Ink—Crayon Commercial Poster.—In the study of lithographic printing inks, the first and most useful is the black printing ink, which, in its finer grade, is known as crayon black. In the United States the lamp black, which largely enters into its composition, is procured in the natural gas regions, where jets of gas are directed against iron plates in an oven-like machine. And when the soot or lamp black has collected to a sufficient depth, it is then scraped off, placed in bags, and in this condition sent to the ink maker. When ground in a suitable lithographic varnish, a slight proportion of blue is added, as the black of itself shows a brownish tone; therefore many of the deepest blacks have a large percentage of blue in them. Transfer ink has already been noticed under a previous head.

Colored Inks.—It is advisable in taking up the study of lithographic colored inks to divide them *into three* classes; first, opaque; second, semi-transparent; third, transparent.

Opaque.—Dense, great covering powers.—Black, vermillion, white, lemon yellow, orange yellow, chrome yellow.

Semi-Transparent.—Medium density, medium covering power.—Cardinal red, scarlet red, bronze blue, milori

blue, medium green, purple, umber, sienna.

Transparent.—Weak in coloring.—Carmine, yellow lake, orange lake, madder lake, krapp lake, green lake, blue lake.

In addition to the above the following special colors are often used:

Opaque.—Concentrated blue, ultramarine blue, French blue, photo brown, flake white, silver white, gloss white.

Semi-Transparent.—Process yellow, bronze red, Jacqueminot lake, Antwerp blue, Bismarck brown, royal purple, permanent purple, Chemnitz white.

Transparent.—Indian yellow, rose lake, emerald green, Victoria green, silk green, smaragd green.

Manufacture of Yellows.—Generally speaking, the yellows which are opaque are made from acetate of lead and bichromate of potash. Soda changes this color from pale to deep. From its composition it can be readily understood that an excess of potash or soda left in the color which is formed by precipitation, would act injuriously upon the work on stone (oleo margarate of calcium), and should a yellow ink cause wearing while running on the press it can generally be laid to this source. The remedy is the addition of sufficient solid oil, such as vaseline, or a compound which is paraffine wax mixed with thin varnish in a sufficient quantity to counteract the wearing quality of the ink.

Lake—All Lake Inks are Coloring Matter Added to a Transparent Base.—Where the term Lake is used in naming lithographic inks it means that the coloring matter has been added to a transparent base called Lake, which will often account for the great variation in price

of articles bearing the same name, and to all appearances similar. The amount of coloring matter added to the base is what counts in the strength, brilliancy and durability of the color.

Yellow Lake.—The transparent yellows, such as Yellow Lake, are prepared from Persian berries and cream of tartar, with alum and with a lake base. This gives a transparent, brilliant color, but, as is common with all colors of a vegetable origin, it readily fades when exposed to light. Its best use is in the making of flesh tints, grays or creams, but it is not to be recommended where an opaque yellow can answer the purpose.

Vermillion.—In reds, vermillion is one of the oldest, most useful and permanent of colors. It is a compound of mercury and sulphur, its chemical name being mercuric sulphide. It is the heaviest of all colors and is manufactured in different strengths (English vermillion being the easiest to work on the lithographic press). When pure it can be said to be thoroughly permanent, but if adulterated with red lead it will blacken on exposure to light in a very short time. It is of great assistance when used with the red lakes, as it strengthens them, brightens them, and at the same time adds some of its own apparent good qualities to those other inks of a vegetable or chemical origin, which are liable to fade, and are termed fugitive.

Madder Lake, Natural and Chemical.—Nearly all the red lakes or colors, except vermillion, are of an aniline or vegetable origin, and, while bright and effective for the purposes intended, can not be guaranteed permanent for any length of time.

Madder lake, as now manufactured, is an instance of this. It was originally ground from madder *roots* and when mixed was a brilliant and permanent color; but lately a coloring matter similar in composition and appearance has been found in alizarine, a product of coal tar. Being cheap in cost, and more uniform in its production, it has entirely superseded the use of madder root while still sold under the name of Madder Lake.

Bronze and Milori Blues.—Bronze and Milori Blues are most in use, and have great covering power when used in full strength, but are particularly transparent when reduced to half strength or lighter. They are manufactured from green copperas, yellow prussiate of potash and nitric acid. Bronze Blue, when drying, has a metallic sheen, which greatly adds to its attractiveness, when printed in the full strength. It dries very rapidly, and in the cans should be covered with No. 1 varnish to prevent rapid oxidation, which causes formation of skin. On account of its composition, care should be exercised in its use in printing, as it will be found of a harsh nature, and, as with lemon yellow, a little litho. compound, which, as before stated, is composed of paraffine wax and No. 0 (or No. 1) varnish, can well be added to this ink. Again caution is given never to use more oil, vaseline or compound than is absolutely necessary, on account of the non-adhesiveness of such ink to paper. Especially so is this the case in the printing of coated or enameled stock. French Blue and Concentrated Blue are now on the market in very strong and powerful qualities. They are generally made from a copper base which is first produced as a green, the

change into the blue tone being effected by the action of caustic soda. It is then thoroughly washed to free the coloring matter from any trace of the chemicals, and, when ground up with the proper grade of lithographic varnish, is ready for use on the press.

Color Manufacture.—The Lake colors (Blue, Red, Green and Yellow) are all in the same class; a transparent base is first made up. The color is formed through the action of acids and chemicals on vegetable or coal tar products, which throw down a precipitate. This, when thoroughly washed to free it from the acids or chemicals used, is added to the transparent lake base and ground together with a suitable lithographic varnish and is then ready for the market.

Raw and Burnt Sienna and Umber.—Raw Sienna, Burnt Sienna, Raw Umber and Burnt Umber are earth colors. Before being burnt they have a yellow tone and after burning they have a brownish tone. They are very gritty to work and should not be used pure or in full strength, if it can be avoided. They are rapid dryers, and, being of a gritty nature, mentioned, it is possible to carry more color on the sheet than with a more uniform substance. This is taken advantage of for the printing of bronze work, which requires a full body of ink on the paper in order to retain and hold the bronze powder. Work printed with this ink will seldom rub off, will dry rapidly and take a good polish or a gloss when cleanly dusted.

Medium Green.—Medium Green is prepared from bichromate of potash and boracic acid. Sometimes ammonium chloride is substituted for the boracic acid. It has a good working quality and is fairly permanent.

Emerald and Victoria Green.—Emerald and Victoria Greens are prepared from copper and arsenic. They are not of a permanent nature, and, generally speaking, should be used with some heavier color to give them body and carrying capacity.

Permanent and Royal Purple.—Permanent and Royal Purples are useful when a pure purple tone is wanted. Generally speaking, Scarlet Lake and French or Milori Blue mixed will give a good purple tone which is easy to work and cleanly and economical in use, but the shade procured by those means is never as bright as with a pure purple ink. The Royal Purple can not be guaranteed for permanency, but is much brighter in tone than the permanent purple. A judicious way is to use them together where possible and thus balance the bright qualities of the one with the permanent qualities of the other.

Whites—Chemnitz and Flake.—In whites the Chemnitz and flake white will be found of most use in lithographic work. They are generally used when a base tint, or color, has to be run on paper to tone same previous to the adding of the colors, thus making a tint or base of a more durable and permanent tone than could be produced by the addition of an equal amount of varnish.

Flake White.—This color is produced from metallic lead with vinegar, which in the Dutch process, in connection with tan bark, is sealed in sheds for a period of almost three months. The lead being placed in spiral ribbons, in crucibles, in which vinegar, or weak acetic acid is poured (the floor of the shed is laid with tan bark), upon the first tier a floor of wood covered with

tan bark is placed. More crucibles are placed in which is also acetic acid and spiral lead in ribbons. When the shed is filled, it is termed a stack, in which may be as many as ten thousand crucibles. The tan bark in combination with the evaporating vinegar forms carbonic acid gas, which attacks the lead and changes its composition from metallic lead to carbonate of lead. This carbonate is washed thoroughly, then ground in lithographic varnish and placed on the market. Generally whites are of a rapidly drying nature and so act when added to other colors. Owing to their composition they have a tendency to lighten or bleach any aniline or vegetable colors with which they come in combination and should, therefore, in all cases be printed at least one shade stronger than the effect wanted when dry.

Manufacture of Litho. Varnish.—The varnish used in lithographic work should be made from pure linseed oil only, and can easily be tested if placed in a small bottle and examined against the light. It should be perfectly clear and nearly colorless. The best linseed oil is called Baltic and comes from Russia. The oil is obtained by crushing flax seed and flax stalks. In manufacturing varnish, linseed oil is placed in large tanks and allowed to stand for some time, by which process the heavier body falls to the bottom and the lighter oil rises to the top. Cocks are placed at different heights on the tanks and as required are drawn, the thickest from the bottom, medium from the center, and thin from the top. As this method consumes quite some time, a more rapid way is employed by boiling the oil. By this process a range of consistencies is obtained which will number

from No. 0000 to No. 5. The oil is also prepared for the market as varnish by burning, and according to the time spent at the process the different strengths of varnish are produced. As this burning darkens the varnish to a brownish tone, it can not be recommended, even if cheaper, for color work, as dirty varnish will change all light tones, making a light blue, grayish; a pink brownish, green yellowish; and flesh tint dirty. Caution should also be taken to see that the varnish has not been adulterated with rosin, as this would tend to thicken the work on stone. Pure varnish is best, and certainly cheapest in the end, when working qualities are taken into consideration.

Dryers.—In printing we have usually three grades of dryers, these being added to the inks in small proportions, so that the drying of the color may be effected in a moderate time. An old and safe dryer is Copal varnish. Then comes Siccatif, either in powdered or paste form, and a liquid dryer which has alcohol for its main ingredient. The first named is certainly the most reliable for lithographic work, being composed of Copal gum, alcohol and turpentine. Its action is always uniform and regular, while having no hurtful effect on the work on stone, if used in moderate quantities.

Siccatif.—The Siccatif dryer has a borate or manganese base and is of a lime nature and evolving heat, thus expels moisture and causing a skin to form on the printed work. As in all other parts of fine printing, great caution should be exercised in its use. An error should rather be made in using too little rather than too much of such a substance.

Liquid.—A liquid dryer having alcohol or ether for its main ingredients, as before stated, acts as an evaporating spirit, and, if not used with great care, will so split up the color, taking all the adhesive qualities away, that when dry it will be found to have resolved itself into a powder, and with the hand lightly passed over the sheet the color will be very easily removed. A liquid dryer should be confined in use to such colors as have been ground or prepared with stiff varnish only.

System in Color Work and in Mixing Colors.—In mixing of colors much will depend upon natural ability in this direction; but a uniform system of working can readily be evolved by careful practice. Generally speaking, work in four colors will be found to consist of fair strength of Yellow, Brilliant Red, a good Black and a medium strength of Blue. Work in six colors will generally consist of the addition of Flesh or Pink and Light Blue or Gray, to the colors used for four-color work.

Economy of a Uniform Color Scale for Combination Sheet Work.—Work has been so greatly systematized that in one large establishment in the East labels in ten or eleven colors and gold must be worked to one uniform scale of colors, so that any label made under this system can be run at the same time on a common sheet with any other label made under the same system. As many as forty different cigar labels have been run successfully on one sheet with no trouble to the transferrer or pressman, simply on account of a firm insistence in the first place that the labels made should conform to one standard scale of colors. This means great economy in the

output of the factory, as a large share of the expense of a pressroom is charged up to washing up of the presses, which can, to a great extent, be avoided under this system.

Four and Six-Color Work.—All four-color work which is run in poster houses and houses doing label work is run under practically the same system and in multi-color work this system has been brought to great perfection, so much so that the work on the six-color press it is rarely necessary to change, even in the slightest degree, the first four colors of the scale.

The remaining two, which I have previously spoken of, being generally a Pink and a Gray. Of these two, Light Blue and Buff can be substituted for light Gray, and light Brown, Medium Red, or Green can replace the Pink. With a definite scale laid out, the first color to mix would be a light Brown. As before mentioned, the Brown inks in use have an earthen base, are gritty to work, and so in press-work we find a prejudice against their use.

A good substituting color for the making of a light Brown is Lemon Yellow four parts, Madder Lake three parts, and Milori Blue one part. These colors will be found to blend well together and work smoothly and cleanly, even on the longest editions.

Dark Brown.—A good durable Dark Brown can be made by an addition of one-fourth to one-half Vermillion to a regular Black ink.

If a more transparent color than this is wanted, Carmine can be substituted for the Vermillion, but as it possesses non-drying qualities, care should be taken in

starting up to see that a sufficient amount of a suitable dryer is added to the color.

Flesh Tints—Several Methods of Mixing.—A durable flesh tint can be made from Vermillion, when thoroughly reduced to one part color in eighty of laketine. A point of Blue or Black will take crudeness away from this color and soften it in tone.

Flesh can be made from Lemon Yellow and Madder Lake, the proportions being about two to one, and thirty to forty parts of such reducing compounds as may be found necessary.

A more transparent flesh can be made from Yellow Lake and Madder Lake, with possibly the addition of a little Raw Sienna. This will make a very pleasant, soft, creamy flesh, but on account of the colors from which it is made being of a weak coloring nature, it will readily fade.

The addition of a little Chemnitz White will prevent the color from fading too rapidly, but the more transparent Buffs are not to be recommended for work which will be exposed to strong light in windows or elsewhere.

The most useful of the mixtures before mentioned is the Lemon Yellow and Madder Lake, as both firmness and softness, as well as permanency, are combined with a good working quality at the same time.

Dark and Light Blue.—In a Dark Blue, Bronze or Milori Blues with a touch of French Blue, or Concentrated Blue, will give a color pure in tone and brilliant in strength.

As these colors are put up in undiluted form for a medium Dark Blue, they require a reduction of four parts to one of color.

To make a durable Light Blue, a good grade of Bronze Blue will be found to give the most useful results.

Color Changes Produced by Overlapping Blue.—In overlapping the Yellow a bright Green is produced, and in overlapping Red, if lakish in tone (in contradistinction to a Vermillion tone), it will produce a serviceable shade of violet or purple.

A little French Blue, or a touch of Purple, will bring the color to a warmer tone and a point of Yellow or Green will change it toward the cold side.

Pink.—In Pinks, especially for fleshes, Madder Lake with a little Yellow Lake to take the bluish tone away, will be found to give soft and clean results.

Medium Red.—For a medium Red the addition of some Cardinal Lake, to bring it up to the desired strength, will be found both economical and to work well in practice.

Grays.—For Grays, both dark and light, there are many combinations which can be effected. The most rapid is French Blue Lake and Black, reduced, of course, to the required strength; but as Black will always tend to dirty a color (that is to say, to take away the purity of tone), it is not advisable to use it on a fine grade of work.

In such cases a nice Pearl Gray can be made from French Blue Lake, Madder, Yellow Lake and a touch of Raw Sienna. Raw Sienna will act as a softening medium in color tone to the mass, and can be left out if greater purity is required.

With these colors, and instructions carefully followed out, creditable work can be produced with intelligent application.

Variations.—Variations which can be made from those accepted standards are innumerable, and of all such it may be said that experience alone can show the way. A diligent study of the complete list of colors used in any establishment, and with a little painstaking experiment on the part of the student, should result in a discriminating and intelligent use of the materials at his hand.

Difficulties in Matching Colored Papers, Silk and Other Fabrics.—Many difficulties will be found in the matching of special colors on paper and fabrics, such as cotton, muslin, satin, silk, etc., but these difficulties will result more from the texture of the material itself than from the actual mixing of the colors.

In all duplication the copy should be brought to as nearly similar a condition of surface as that of the sample submitted; that is to say, that if a piece of cloth is being imitated the surface of the paper after the work has been printed, should be roughened in imitation of the cloth.

Very close reproductions of oil paintings and water colors have been made, which have been greatly enhanced by the application of a proper roughing in canvas or crayon effect.

CHAPTER X.

Printing—Preparing Ink for Use.

PREPARING the Printing Ink for Use.—With a suitable knife, remove from the can a piece of ink of the size of a chestnut, and place it upon the slab. From the varnish-can take as much *thin* varnish as will lie upon the end of the palette-knife, and transfer it to the upper part of the slab. A *small* quantity of this varnish must now be mixed with the piece of ink by means of the palette-knife. At first there will be a difficulty—the ink being very tenacious will not easily separate, to allow of mixture with the varnish; but by industriously working it with the knife it will gradually yield and be incorporated with it. When this has once taken place, more varnish may easily be added if required. It is to be supposed that our students' first essay at printing will be a simple subject in line-work, a bill-head, circular, or such like. The temperature of the room in which the printing is to be carried on being moderate, the mixture of ink and *thin* varnish is to be such that it will run slowly off the palette-knife when held in a position to allow it to do so. It is better to err in having the varnish too thick than too thin. When the ink has been brought to a proper consistency, it is to be scraped off the slab and laid upon that portion of it farthest from the printer.

A small portion of ink is next taken up on the palette-knife, and spread along or placed in small pats upon the roller, which is now to be rolled over the clear portion of the slab until the ink is evenly distributed over both. To do this properly requires a certain "knack." The roller must be taken by the leather handles which cover the wood ones, one in each hand; rolled away from the operator and back again to the near edge of the slab; then lifted off the slab, and by a forward bending of the wrist brought down again to the place whence it was lifted. This motion, which should be made with the elbows fairly close to the body, will change the position of the roller in relation to the slab so that each point on the roller's surface will come in contact with a different portion of it. By repeating this operation several times, accompanied by a change of position laterally, and by turning over the roller so that the handle which was in the right hand may now be in the left, a good distribution of the ink will be effected.

The next thing to be done is to lay the paper on the stone in such a manner as to prevent the impression being "slurred" or doubled. To effect this the paper must not shift, or be shifted between the time of first laying it on the stone and taking the impression.

If the sheet is too large or too flimsy to be treated in this manner just described, it must be laid upon the stone by taking it in both hands.

The impression when lifted off should be examined, to see whether the operation has been properly performed. It will, however, require either an experiencd or artistic eye to determine this point, and we now proceed to state what are *the essentials of a good impression:*

First.—As we have been printing in black ink, the lines of the drawing or writing must be black also; or, in other words, they must *not* be gray.

Second.—They must not be wider or blacker than they were upon the stone; such impressions are called "smutty."

Third.—They must not be "ragged" or broken; or, as printers call this defect, "rotten."

Grayness and smuttiness are respectively the result of too little and too much ink; while, if the work is good upon the stone, rottenness of impression is caused by insufficient pressure.

Manipulation of the Roller.—Attention is now directed to the different results obtained by varying modes of using the roller, independent of the quality of the ink upon it. It is not to be understood that the quality of the ink is unimportant, far from it; but the point we are now establishing is, that with the same ink and the same number of passes of the roller over the stone, different qualities of impression may be produced. If the student will fix upon his memory the theories of the varnishes and the methods of using them upon the roller, he will be in a position to profit by the experience that may be gained in printing, his mind being stored with a knowledge of the principles that must govern the practice.

Bearing heavily on the roller "feeds" the work more rapidly than bearing lightly on it.

Light pressure on the roller transfers but little ink to the stone, and also takes off some part of that which has been previously applied by heavy rolling.

Slow rolling produces similar effects to heavy rolling.

Quick rolling produces similar effects to light rolling; consequently—

Slow and heavy rolling, combined, produce the maximum feeding effect upon the work; while—

Quick and light rolling combined has the greatest effect in clearing an already over-inked job, and making the work look sharp.

Passing now to the influence of the ink upon the quality of the impression, the first axioms will be easily understood:

Too little ink upon the roller will produce gray impressions, under ordinary conditions of rolling.

Too much ink will, on the contrary, give smutty proofs.

Now in following out this subject of the ink, we may add to the foregoing axioms the following:

Thin ink feeds the work very freely, and if too freely used will cause it to thicken and grow smutty.

Strong ink leaves the roller with difficulty, and necessitates slow and laborious rolling.

Slow, heavy rolling with thin ink will produce the maximum effect that can be obtained under similar conditions of temperature.

Quick, light rolling with strong ink will have the greatest possible tendency to bring the ink away from the stone.

Paper.—The choice of paper is a very important matter in lithographic printing, if the beauty of the work is of any consideration. It is a subject upon which much ignorance exists generally, as every lithographic

printer must admit. The clerk or other person who receives the order from the customer, not knowing any better, is quite willing to execute it upon any proposed paper. He is probably afraid to suggest to the customer that writing-paper is not a fit material upon which to execute any kind of printing. He takes so many orders for letter and account headings on it that it does not occur to him that there is no necessity for adopting writing papers when nothing has to be written. Most circular letters for business purposes would print better and cleaner upon *glazed* printing paper or half-sized plate paper than upon writing paper.

Preparing India Paper for Printing.—There is an imitation of India paper that is free from the spots and blemishes of the genuine paper, and though it does not yield so good an impression, its freedom from specks is a great recommendation. To both kinds of paper the following instructions will apply:

Take the India paper in full-sized sheet, and brush over the back with rather thin flour paste, and hang it up to dry. Damp the plate-paper in the manner described on page 67. Cut up the India paper carefully to the size required, and put a piece between each two sheets of plate-paper—*i. e.* one piece for each. The India paper should be about half an inch or more *larger* each way than the work to be printed upon. The larger the work, the more margin will be wanted. Make a mark upon the stone to correspond with the size of the plate-paper, and another to agree with that of the India paper. When printing, first lay down the India paper *pasted side up,* and upon it the plate-paper; the paste, being

damp, will be found to adhere firmly to the plate-paper, which is always slightly damped, after being submitted to the pressure of printing. It will be seen that this is a combined method of printing and mounting at the same time. In like manner photographs may be mounted, where there are many of them to be done.

CHAPTER XI.

Printing—Defects and Remedies.

WE shall now endeavor to explain, aided by the principles we have been considering, how certain defects which may appear in the proof may be remedied, if that be possible.

When the proof does not appear so firm as the drawing on the stone, yet the ink looks black upon the paper, increase the pressure.

When the print looks altogether too dark, there is either too much ink on the roller, or it has been rolled in by too heavy pressure, or the roller worked too slowly. The paper, if smooth and hard, may print better with less impression, or the ink may be too thin. These observations suggest the remedy.

When the impression though firm is pale, there may be insufficient ink on the roller. It may also be too thin. The roller may have become covered with gum, or have accumulated a film of dirt from long use without change of ink. Try a good "knocking-up" on the ink-slab, and, if that does not cure it, scrape off the old ink and apply some more. This defect may also proceed from rolling too quickly and lightly.

When white streaks occur in the whole length of the proof, the scraper is notched or otherwise uneven. Make it level with coarse cabinet-paper or a plane.

When the impression is always too light at one end, there is a deficiency of pressure there: pack the stone at that end.

When the impression has one or more light places that do not show on the stone, the stone is hollow, or the tympan or backing-sheet thin at such places. Try a piece of blanket for the backing, and if that is not successful, paste small pieces of paper on the backing-sheet or tympan where it occurs. To do this properly, *tear* the paper into shape; paste or gum one side; lay it on the stone where required, adhesive side up; bring the tympan down upon it, when the paper will be attached at the defective place.

When the drawing is missing or has failed to print at one end, the scraper has been set too far on the tympan, or not pulled far enough.

When, notwithstanding all precautions, the drawing yields only pale impressions; this can only occur when the paper is too wet. It usually occurs when the paper is not only too wet, but also highly sized.

When the paper tears, and is partly left upon the stone; this commonly occurs with plate-paper when it is imperfectly damped. Give it more time to lie by. If that will not do, use a thinner ink, as that can be used on plate-paper with success, because each impression clears the stone.

The impression being, it is hoped, what it should be, the printing may be proceeded with. For each pull the stone must be first damped, and then inked; but in these two operations defects may occur which attract the printer's notice before he takes the impression.

When on the rolling in being recommenced, black patches may occur, the stone has not been damped at these parts. Damp again properly; roll briskly and they will go away.

When, after rolling several times, the ink begins to "catch" as before, the stone has become too dry. It may arise either from too long-continued rolling without re-damping, or the temperature of the room being too high. Remedy as in the last case.

When the roller does not turn in the handles, but slips over the work, the stone is too wet.

When, as the printing proceeds, the close lines or dots join together, or the work becomes darker all over, the ink is too thin. Wash out with turpentine and a little oil, but be careful to have the stone quite wet at the same time. Roll in again with an ink made stiffer by having less varnish in it, or one of a stronger nature. Gum in and let it lie for a day or two if possible. This defect is more likely to occur with hard papers.

When the drawing grows thin and pale, the roller may have become dirty, or the ink may be too stiff, in which case use thinner ink.

Advice to Beginners.—In summer, use medium varnish to reduce your ink; in winter, add a little thin varnish to it.

Avoid wetting the stone too much at a time, or the roller will not only be liable to slip, but will become so glazed as not to ink properly until it has been "knocked up" on the slab again.

After proper damping, count the number of times that the roller can be passed over the stone before it

begins to soil it, then in your printing do not make so many passes by, say, two.

When the roller begins to make an audible sound in going over the work, it is a sign that it is time to leave off rolling.

Having inked your work, "knock up" the roller ready for the next inking before taking the impression.

Be careful to keep the edges of the stone clean, avoiding rolling over them if possible. If they are once allowed to soil the backing-sheet, it will be difficult to prevent the edges from becoming again dirty.

Work with as little ink on your roller as is consistent with obtaining a good impression.

The beginner will find it useful to touch the stone occasionally with the gum-sponge, to assist in preserving the coating of gum upon it.

Keep separate sponges for gum, weak acid, and wetting the stone. Let them vary sufficiently in size, so as to be readily distinguishable from each other, which will lessen the liability to accident, in mistaking, for instance, the "acid sponge" for the "gum-sponge." Keep also another good-sized sponge for use with perfectly clean water only. This will be useful when washing a stone previously to making corrections.

Slurring signifies a doubling of the lines or the dots composing the impression at some part of it. It is usually found at or about that part of the proof which last received the pressure, and may proceed from one of several causes, though its immediate cause is always the same—namely, the shifting of the paper between the time of its being placed upon the stone and its passage under the scraper.

Setting-off is a transferring of some of the ink before it is dry to the back of the paper of the impression lying next to it. It ought to be avoided in careful work. It is chiefly owing to one of two causes: first, the hardness of the paper, and second, to the use of ink unsuited to the paper. Hard, smooth writing-papers are very liable to it. When the copies are placed one above another until a heap is formed, the under ones receive most pressure and are more liable to the defect. Black printing-ink dries very slowly, but the printer does not like to use dryers in it, because it necessitates the use of some solvent for removing it effectually from his roller, the frequent use of which deteriorates that instrument very materially. The turpentine used, and the amount of time involved in washing the roller, are, of course, items that cost the employer something, so that it is usual to put such works into small heaps, to lessen the weight upon the bottom impressions and to give them more time to dry.

It frequently happens, however, that circulars and other work are wanted for immediate use. The customer may be accommodated at a trifling extra expense, by the application of powdered French chalk. It is to be applied with a small pad of cotton wool, first dipped into the powder and then rubbed over the impressions, after which they may be handled and folded with impunity.

Printing Chalk Drawings.—If the student has mastered the theory of the inks and varnishes, and applied them in the practice of printing from ink drawings, he will now be able to take in hand printing from a chalk drawing. There are some differences between the ink

and chalk printing, which it will be well to point out before proceeding with the instructions for printing. In the first place, the stone being granulated, the dots whose aggregation make up the drawing, do not lie in one plane. This necessitates the use of a roller having sufficient "nap" to reach the bottom of the grain. The grained surface also disposes the stone to remain longer damp than does a polished one. The rough stone so rapidly wears away a damping-cloth that two sponges must be used, one to apply the water, and the other to spread it.

Where an assistant is employed at the press, a roller similar to the inking roller, but covered with a suitable material, may be used for damping the stone, as is done in machine printing. A boy with a little practice would thus damp more evenly than by the use of a sponge. The drawing would suffer less abrasion, and would probably yield a greater number of impressions.

Re-etching.—It must be understood by the young printer that when the chalk has been once removed, the printing-ink alone has less power to resist the action of acids than the chalk had, and requires some protection, previous to the renewed acidulation of the stone. Inks containing copal-varnish, asphaltum, and similar substances, might be used for this purpose; but an effectual and simple method, which does not involve the use of another roller, consists in *dusting* powdered rosin over the work after rolling-in, and permitting the stone to dry.

Defects sometimes arise from Unequal Etching, and show themselves in printing as darker spots and patches than the surrounding parts, which were even enough when the drawing left the hands of the artist. These

can only be remedied by etching the parts that are darker, and so bring them to a level tone with the rest, by the application of a camel-hair pencil containing dilute acid, and immediately wiping away the acid with a sponge to prevent its acting further than intended.

Defects Arising from Over-etching.—When the drawing has had too much acid applied in the etching process, the light tints are perhaps so reduced that the drawing has a worn-out appearance, as if a very large number of impressions had been taken from it.

CHAPTER XII.

Chromo-Lithography—The Key-stone—Order of the Colors.

IN treating of Chromo-Lithography, we propose first to point out those conditions and processes which are common to all the various methods of producing colored effects; then we shall give a description of simple color-work, suitable for plans, labels, show-cards, &c.; next, of tinted lithography, which is used in subjects of more artistic character; and, finally, that combination of the former methods which is usually denominated Chromo-Lithography or Oleography, when applied to the reproduction of artistic subjects. In this manner we shall have occasion to introduce some things in the first part which it will not be necessary to repeat in the other two, of which the methods of making set-off and registering the sheets may be cited as examples.

It may be stated generally that all lithographs in two or more colors are printed from two or more stones. That being so, it will be seen that some method must be employed, first, to get a correct trace of the subject on the first stone made upon the second; and, second, of being able, in printing, to lay the sheet so correctly in position that the second printing may fall exactly into its place upon the first. To attain the first of these conditions we must have what is called a key-stone.

Key-stone.—In the ordinary run of show-card and label-work this stone is used for finishing, but in work of more artistic character it is usual to employ this stone as a means of getting all other colors in their place, and generally to omit it in printing. It is necessary, in making this key-stone, that there should be lines to indicate either the junction or separation of each color from every other, wherever any kind of distinction has to be observed. In show-cards it is usual to edge nearly all the color with an outline, and this is then all that is necessary for the purpose of a key-stone; but circumstances may occur in which it is necessary to bring two printings into juxtaposition without the intervention of a separating line of black or other color.

To avoid confusion and possible failure it is best to make a tracing in indistinct outline of the subject—portrait, landscape or other design—upon the key-stone. We give here the several most approved methods.

We may, however, take this opportunity of informing the student that he must on no account attempt to make a key-stone in a hurry, such a course being certain to end in confusion. He should take every possible care to make the key-stone thoroughly trustworthy, studying each bit as he proceeds, so as to find out the best mode of producing the imitative effect required.

First.—Very transparent tracing-paper may be made by coating fine tissue-paper with crystal varnish. Coat it on one side, and let it dry, and then coat it on the other. The varnish may be made by adding spirits of turpentine to Canada balsam until thin enough to be used with a varnish-brush, the solution being effected with a gentle heat.

Second.—French tracing-paper, *papier vegetal,* may be oiled, to render it more transparent; but care must be taken to avoid bringing the oiled surface in contact with the stone or transfer-paper.

Third.—Ordinary tracing or other thin paper may be wetted with spirits of turpentine or benzoline, and the wetted side applied to the glass or paper photograph. The tracing may then be made in pencil. The liquid will soon evaporate; but, if the paper becomes opaque in consequence, a corner may be lifted and another drop of the fluid introduced, which will instantly restore the transparency. When the tracing is completed, it and the photograph will dry rapidly and the latter will remain uninjured.

Fourth.—Sheets of transparent gelatine may be laid over photographs or paintings, and the tracing made by scratching the outline with a sharp steel point. The scratches thus made are to be filled with powdered red chalk, dusted on with cotton wool: the scratches being rough, retain the powder, which is rejected by the smooth surface of the gelatine. If the gelatine, thus prepared, be laid upon a stone and passed through the press, a red chalk tracing will be left upon the stone. The scratches may also be filled in with lithographic writing-ink, dissolved in spirits of turpentine, wiping it clean off the smooth part of the gelatine. This being laid upon the stone as before, and subjected to pressure, will leave an ink outline that may be rolled up as an ordinary transfer. Or the gelatine may be treated, after filling-in with ink, as an ordinary transfer, by damping it between sheets, applying it to a warm stone, passing through the press,

and finally washing it off with hot water. It requires a very slight etching before rolling-up.

Fifth.—If the photograph to be traced is of no further value than furnishing a copy for the draughtsman, it may be treated in the following manner:—With india-rubber, paper-cleaner, or ink-eraser, remove from the surface of the photograph all tendency to greasiness; outline every detail with lithographic writing-ink, which, after the cleaning referred to, will adhere readily to the photograph, treating it as far as possible as a sheet of transfer-paper. Set a stone in the press, and make ready as for ordinary transferring; pour spirits of turpentine upon the stone, and spread the spirits all over. Let it stand a few seconds to be absorbed. With one stroke of the squeegee remove the superfluous turpentine. Now quickly lay the inked-in photograph upon the stone, lower the tympan, and pass once through the press, under heavy pressure. The stone having been uniformly damped with the turpentine, the latter acts equally in softening the ink, which is then absorbed by the stone. If there should be too much turpentine, the ink will spread; and if too little (which may happen if the stone is allowed to dry somewhat before the photograph is laid upon it), sufficient ink may not be absorbed to roll up. However, with ordinary care on the part of the draughtsman and the printer, success is certain. The stone having been gummed and rolled up, impressions may be taken. If a key-stone be wanted for color-work, nothing but the register-marks will require to be added.

As, however, some might prefer a red chalk outline, we may state that it can easily be obtained as follows:

Instead of taking a weak impression on printing-paper, take a full one on highly-sized and glazed writing-paper; place upon it a quantity of finely-powdered red chalk; holding the paper by opposite edges, raise and lower each hand alternately, until the chalk has been brought into contact with every part of the outline; pour off the superfluous chalk, and finish by giving it a smart jerk or two to remove the remainder from all parts except the lines. The prepared print may then be laid upon the stone and passed through the press, as before described. This method is very applicable for drawings in ink.

This method of transferring to stone for the purpose of obtaining a mere faint tracing for a guide in the actual drawing, may appear more complicated than the ordinary tracing and retracing; but where the details are minute and numerous, it will be found that time is saved by its adoption; while the artist, being saved the drudgery of the intermediate operation, will approach his task with better spirit, knowing that a more correct trace is before him than would have been obtained by any other method.

The Set-off, or Faint.—By this is meant the trace produced when an impression from the key-stone is laid down upon another stone and pulled through the press. Now, the one essential condition of this is that the trace, set-off, or faint impression, shall be exactly of the same dimensions as the original from which it is made; for if it be not, it is quite evident that impressions from the two stones will not fit each other when printed upon the same piece of paper. To ensure this, attention must be given to the following:

First.—The impression from the key-stone must be pulled upon dry, well-rolled paper.

Second.—The key-stone should be allowed to become dry before the impression is taken, so that the chances of the sheet absorbing moisture, and thereby expanding, may be reduced to a minimum.

Third.—The impression when taken should be laid down upon the stone as soon as possible, so as to prevent the sheet either expanding or contracting by any change in the state of the atmosphere.

Order of the Colors.—The order in which the colors should succeed each other in the course of printing is a matter of much importance, not only as regards the effect of the finished print, but as regards economy of time. In a case in which bronze powder, metal, or any dust color, is used, this ought to precede the other printings. When the bronze must be introduced after other printings, it will be found almost imperative to prepare the sheets with some semi-transparent powder, such as talc, rubbed on and well dusted off, to prevent the adhesion of the bronze, which would otherwise attach itself to any part that might not be thoroughly hardened.

There is another order of succession, which is based upon the fact that while some colors are opaque others are transparent. As a rule, the transparent color should succeed the opaque one, because the former allows the latter to be seen through it, and is modified by it, for which reason the transparent colors are usually reserved for the finishing ones.

Further, it may be stated that another order may depend upon the hue of the color desired; thus, for instance, a Prussian blue over a chrome yellow might make a dark, cool green, but the reverse order would give a warmer and

lighter green. For the same reason a crimson-lake over a blue yields a richer purple than the opposite order would give.

For positive colors it may be stated, as a general rule, that they should succeed each other as follows: First, bronzes or dusted colors; second, blues; third, reds; fourth, yellows; and fifth, the outline or finishing colors.

In the matter of transparency, the student may observe that those colors which are dark in the mass are usually transparent and fit for finishing with, while those which appear much the same in the lump as upon the paper are opaque. But there are some exceptions, notably raw sienna and emerald green. In this connection it may be stated that though the opaque should generally precede the transparent colors, there are instances in which the reverse order is to be preferred.

CHAPTER XIII.

Registering.—Application of Principles.

REGISTERING.—By this term is understood the adjustment of an already printed sheet to the stone, in such a manner that the further work about to be printed on it shall coincide with the spaces intended for it.

There are several methods more or less adapted to obtaining this important object, but it must be observed that in each case the key-stone must have applied to it appropriate marks adapted to facilitate the subsequent operations, and that this preparation varies somewhat in each method. To facilitate reference, we will number these methods, commencing with the simplest:

First: By Lay.—This, in many hands, is a very effectual means of obtaining register, and is the simplest possible; but the size of the paper to be used should be determined before the set-off is made. It is true that this is not absolutely essential to the method, but it greatly facilitates it in every way. The size of the paper having been fixed upon, a "lay," corresponding to the edge of the paper, is made on the stone, by which the subject is brought into proper position upon the sheet, and this lay is then drawn with fine lines in lithographic ink in such manner as to print upon the sets-off and to remain all through the printing. A set-off is now to be made for

each color, and this "lay" mark is to be made permanent. If the color to be printed be a dark one, the mark may be carefully inked over at the same time that the rest of the work is done; but if the printing is to be a light color some method must be devised of making this mark not only indelible, but dark, so as to be readily seen by the printer; and this may easily be accomplished as follows: Cover the place with gum, through which, when dry, make scratches to coincide exactly with the marks they are intended to replace. With a pen and common writing-ink, go over these scratches, and when dry, if the gum be washed away, well-defined marks will be left that will last all through the printing.

In using this system all that is necessary is to accurately adjust one corner and edge of the paper to these marks all through the printing; but care must be taken that the paper possesses well-defined corners and edges. If the paper should be found to expand a little, a good workman will, by laying the sheet a little over the mark in the direction required, be able to make the necessary allowance to preserve the register. In many kinds of work this system will be found all that is required, and indeed in many houses scarcely any other is used.

Second: By Needles.—In this mode sufficient marks are usually to be found among the work to answer the purpose of registering; but occasions may arise in which a small dot or cross may be made near the centre of the shorter edges of the paper on opposite sides of it.

To take an example: let it be supposed that the border line of a subject be chosen for registering by. Make, with a sharp-pointed scraper or other convenient tool, fine

holes in any two opposite corners of the set-off upon the stone. Some registering needles must now be provided, and may be made thus: Two pieces of wood or cane about 1½ inches long, of the thickness of a black lead pencil, are to have inserted in each of them a moderate sized sewing-needle, with about an inch of it projecting. If the point be inserted in the wood and the eye end broken off and repointed, the tool will be better. Another similar piece should be provided with a needle of the same size having its point preserved.

Thus equipped, the printer may proceed. The sheet printed first must be pricked through exactly at the corners which are intended to be used, and which correspond to the holes in the stone. Through these holes in the sheet the needles are to be inserted from the back. The printer now takes the sheet, contriving to hold the needles and the paper at the same time, and inserting each point into its proper hole, allows the sheet to drop from his fingers on to the stone. He then holds the sheet in position with his little fingers, while he withdraws the needles and afterward carefully withdraws his fingers, thus leaving the sheet, if the operation has been carefully performed, in its proper position upon the stone. When it is required to make allowance for expansion of paper, the needles may be inclined in the direction necessary to correct the error.

Third: By Fixed Points.—The previous method may be varied by setting the two needles in a lath of wood, so as to correspond with the holes in the paper and the stone. With a lad to assist, this way will be found a quicker one than that of using the needles separately, but will

possess the disadvantage of not permitting them to be inclined in opposite directions, as is sometimes necessary.

We have an opinion that a perfect method of register should admit of the following conditions: (a) That it should depend for its exactitude upon the sense of touch; (b) that the guides should be attached to the stone itself; (c) that the guides should be capable of being moved so as to accommodate any expansion of the paper subsequent to the first printing; (d) that there should be no necessity for pricking holes in the sheets by hand, as that introduces an element of error.

We are happy in being able to describe two methods by which this can be accomplished.

Fourth: By Points in Stone.—Get the following materials and tools: Some lengths of lead such as is used for balancing ivory and bone-handled table knives*; a drill that will make a hole of the same diameter as the lead; a brace for rotating the drill; some steel music wire, about 22 of the Birmingham wire gauge; a small chisel or a broken palette knife ground off square and sharp; a small wood mallet; and a fine flat parallel file, about one inch wide, with safe edges, but no handle.

Thus equipped, the lithographer may proceed. We will for the present suppose that the stone and sheet to

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*If there is any difficulty in obtaining these pieces of lead, they may be made in the following manner:—Procure a piece of straight brass tube, ¼ in. in diameter, and about 3 in. long. With a fine saw cut it entirely through, lengthwise, and carefully remove the burr from the inside where it has been cut. Holding this piece of tube in a pincers or hand vise in such a manner as to close the slit, rest it on something to close the bottom end, and pour into it some molten lead. When set, the tube may be loosed, and will by opening a little at the slit, permit of the lead cylinder being pushed out.

be printed are about equal in size. The case of a stone larger than the sheet will be treated of subsequently.

At the centre of each end of the key-stone, about half an inch from the edge, drill a hole about half an inch deep; cut off a piece of lead five-eighths of an inch long, and with the mallet slightly taper one end. This must now be driven into the hole, and the projecting part cut level with the stone by means of the chisel. A piece of the wire is to be slightly pointed with the file, and then a notch made about one-fourth of an inch from the point at which it may be broken off. Drive this into the lead until only one-sixteenth is left projecting. Over this place a bit of stout writing paper, and with the safe edge of the file resting upon the paper, bring the bit of wire to a fair point.

In the same manner treat each end of each color-stone, as far as the insertion of the lead goes, but put in a point at one end only.

In taking the impressions of the key-stone for the set-off, simply lay the sheet to a mark; but before it is lifted from the stone, press the finger on the points so as to make them puncture the paper. Each set-off will thus be pricked exactly in the same manner. In laying these upon the stone, one hole is to be placed over the point, and the other hole over the lead without a point; near which end a little strong gum should be placed, so as to temporarily hold the sheet. The set-off sheet having been submitted to sufficient pressure (taking care that the scraper only acts upon that part of the stone between the points), a hole must be accurately pricked into the lead through the hole in the paper. This having been properly

performed, the stone is ready for the artist, as the insertion of the second point may be omitted until the stone is placed in the printer's hands for proof, when it may be inserted as previously described.

In the actual process of printing the first impressions are laid to a mark, and the sheets punctured as described for taking the set-off impressions. The subsequent ones are obtained by laying the holes over their proper points, the printer being able, with very little experience, to feel the points through the holes with his forefinger. Any expansion of the sheet can be provided for by driving a small dull punch into the lead alongside the point, which is thereby shifted in the opposite direction, and will so remain until again moved by similar means.

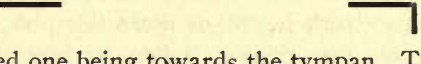
If it be necessary to use stones larger than the sheet of paper, it is clear that it will not do to drill a second hole far up the stone, as that would probably spoil it for future use. In that case the mark, instead of being made upon the lead, must be made upon the stone, and a cross scratched through it with lines about one inch or more long. For a point, get a piece of thin brass, about three-fourths of an inch square, and let the tinman tin it at the back, and drill a hole to match the wire near one corner, and solder it (the wire) in, letting it stand one-sixteenth high, as before. By means of a blowpipe and a piece of shellac this may be firmly attached to the stone, the point being set at the junction of the cross scratches. This point may be slightly moved at any time by warming it by means of the blowpipe. When done with, it may be removed altogether by setting a square-edged punch or dull chisel against it, and giving it a sharp tap with the mallet.

Some of the few drawbacks to this method of registering may be got rid of by drilling the holes in the side edge of the stone and using only lead foundations for the points. If they are put, say, 14½ inches apart, they will serve for crown, post, royal, and demy folios, and larger stones may be similarly treated for larger sizes.

Where the cardboard or paper is too small, pieces of paper to carry the point-holes may be gummed to the edge. These pieces of paper can be torn off when the printing is completed.

Fifth.—We have used with considerable success the following method, which enables the printer to see as easily what he is doing as in the simple way described first. Where there is sufficient margin, it is not only the easiest, but much the quickest system.

Two pieces of brass, about three-fourths of an inch long, and shaped like the letters I and L respectively, are to be tinned at the back and fastened to the stone with shellac, corresponding to the edge and corner of the paper in the following position:



the L-shaped one being towards the tympan. The scraper must be set in its box in such a manner as to avoid these brass register marks when the impression is being taken. A pair of these having been fitted to the keystone, the set-off sheet is to be carefully set in the corner of one and against the other, and the impression taken. Similar marks must be put to each stone, and the set-off sheet being laid against them exactly as at first, an exact register must be the result when the paper is applied to them in a like manner in the printing.

The Influence of the Paper Upon the Register is frequently very great, and we will point out some of the conditions necessary to success in registering.

First: Paper for color-printing must be well rolled, so as to stretch it as much as possible. This is very important, because printing paper as received from the mill, under ordinary pressure used in litho printing, will stretch sufficiently at the first pull to make "slurring" almost inevitable.

Second: The temperature and hygrometric state of the printing room must be maintained as equal as possible, as it is no uncommon thing to find the sheets printing in register one day and out the next, in consequence of a wet day succeeding a dry day, or vice versa. This effect is sometimes set down by the printer to the action of the press in stretching the paper; but where that has been well rolled, such is not the case. Paper that has been subjected to the rolling machine sufficiently to glaze it will not stretch under the lighter pressure of the lithographic press.

It will sometimes be convenient to print views and other similar work in one or more tints, on damp paper, in which case care must be taken, by keeping them in a heap, to prevent their becoming dry at the edges, which causes them to cockle, and slur in the printing.

In these cases it is therefore necessary to commence the printing upon dry paper, and to allow free access of air to the sheets between the printings, which can most easily be accomplished by setting the impressions in a pile, and keeping each separate from the other by means of laths of wood, printer's reglet, or strips of cardboard.

This provision for the drying of the ink has the disadvantage, however, of exposing the paper to all the alternating influences of heat and cold, and dry and damp.

Of the Surface to be Given to the Stone.—In ordinary color-work it is customary to employ polished stones whenever the pen or brush is used for producing the required effects. When it is necessary or desirable to use chalk, or employ tints, grained stones must be used. Grained stones are employed in tints, even though there may be no gradation of color required, because it is found by experience that they carry the ink more evenly, and produce more level printing than do polished ones. The nature of the grain to be employed will depend upon that of the work; but as a general rule a somewhat coarser grain is given to stones for color than to those for black work.

Setting-off of Colors upon the Stone may be prevented by dusting the previously printed sheets with powdered talc, magnesia, powdered chalk, or other similar substances, but the process should be avoided as much as possible, as it somewhat injures the brilliancy of the colors.

Application of Principles to Practice in the Production of a Simple Color Job.—For an illustration of this subject we will suppose that a show-card is to be printed in the following colors: gold or bronze, a warm tint, emerald green, vermilion and black.

The first thing to be done is to make a colored sketch, in which the arrangement of colors must be definitely settled, because it will not be advisable to deviate from it during the making-up of the stones. When this has been done, the artist must draw a keystone, in accordance with

the principles laid down in a preceding paragraph, not forgetting to make such provision for registering as may be necessary, according to the particular method to be adopted, which in this instance we will suppose to be that of the fixed points upon the stone. With this in view, the drawing must be placed upon the stone in such a position as to accommodate it in regard to the place of the fixed point.

After the printer has rolled up the work, he must affix a second point to the stone, and then prepare four other stones to receive the other colors. Four impressions having been taken on well-rolled paper, three of them are to be dusted and laid upon polished stones, while the black one, not dusted, is put upon a grained stone. These set-offs, having been pulled through the press, are to be marked for register, in accordance with one of the methods previously given.

The grained stone is intended to receive the tint, which may be prepared in the following manner: The margin and all other parts which are to remain white should be stopped out with gum. This will be found to be an easier method than painting in, with lithographic ink, all those parts which are to remain as tint. If there should be time to permit of the drying of this tint thoroughly before the next stage, it will be as well to allow the tint to be underneath the bronze, more especially if the paper or card has an absorbent surface. If the tint be a light one it may underlie any other color which may be intended to be dusted on. The reason for having the tint thus to underlie the dusted color is that the paper shall be less likely to absorb the ink, and weaken its power of

holding the dusted color. Another advantage it would have would be that of not showing any little inequalities of registering. When the gum-ink is dry, the stone may be covered with drawing-ink and turpentine, or in fact almost any kind of greasy matter free from water. Some time should then be allowed for it to penetrate the stone, after which the gum may be washed off and the work rolled up. The other stones may be drawn upon with lithographic ink, care being taken to keep each color to its proper stone; but where two colors can be kept sufficiently apart to be applied by the dusting-on process, they may be drawn on one stone. Thus, in the instance before us, as we have to use an emerald green, the varnish for it may be colored to pale blue, and that will take also a blue dusted color, so that, if not too near each other, both may be employed on the one printing with a little care. In filling in the stones the artist should observe that by covering his outline with each color he will improve his chances of good register, and where there is a broad black line he may carry his color considerably beyond its edge, because the black printing will effectually hide the under color.

When those colors which are dusted are applied to the show-card, the vermilion, and then the black, may be printed next in order. In making up the red stone, it will be as well to so arrange it that the color may underlie the black, which will thus have a greater richness. Care should at the same time be taken that the red is kept well within the outline of the black, so that it may not show when a little out of register.

It must be borne in mind that as the colors are to be printed over each other they should have dryers in them to facilitate the work. Under the ordinary circumstances of one printing the absorption of the ink by the paper will hasten the drying, but where one color is superimposed upon another this does not take place, and it becomes necessary to add dryers to the ink.

CHAPTER XIV.

TINTS.

AT the end of the last chapter we described the manner in which to a simple job in colors might be applied the methods previously detailed for making keystone, set-offs and registering. In the practice of chromolithography it is, however, very necessary to become acquainted with the methods of making tints which imitate more or less effectually light washes of color, as seen in water-color drawings, etc. These methods we proceed now to point out.

Different Methods of Making Tints.—The method of producing a tint given in the preceding chapter, though the simplest one, is only adapted for producing one uniform color, and therefore is very limited in its application. If the student will examine some of the subjects frequently to be met with, which are printed in black and one or two tints, he will notice that each color or tint consists of more than one gradation. If he will study also those imitations of chalk drawings on tinted paper which are generally imported from Paris, he will find that the lights appear as if they had been laid on with white chalk.

The modes in common use of producing tints depend upon the principle of laying some fatty matter on the stone in such a manner that, if left in that state, it would

roll up of full strength all over, unless part of it had been removed by etching with dilute acid or scraping, or both combined.

Tints in which White Chalk is Imitated.—For this method a somewhat coarse, but very sharp-grained stone must be employed, and the set-off of the drawing must be made upon it in such a manner that the subject can be distinctly seen during the several subsequent stages. As this imitation of white chalk is to be produced by scraping, it is desirable that the artist should have his ground color sufficiently dark to enable him to estimate properly the effect he is producing. A dark ground would, however, obliterate an ordinary set-off, but if it be laid down with turpentine it will show through the ground. If the ground for the tint is, on the other hand, so dark as to obscure even this kind of set-off, a dusted one may be laid on the top of the ground after the latter has been put on.

The practical treatment will be as follows: On the grained stone make the set-off. With gum and acid stop out the margin and high spots. Then lay the ground. If the set-off do not now show sufficiently, an impression dusted over with red chalk or vermilion may be registered upon it, and passed through the press with light pressure, provided the ground is hard enough to permit of it.

The ground forming the tint must possess the following properties: It must be hard enough to allow of the scraper removing it in parts without smearing. It must resist the action of the acid sufficiently to roll up solidly, after an etching which is strong enough to keep the scraped parts clear. Thus it must not be too greasy, but

must be soluble in solvents that dissolve fatty matters. There are several substances which can be used for this purpose, but perhaps the most convenient are asphaltum or Brunswick black, and copal varnish, the latter of which will require some coloring matter added to it to enable the artist to see what he is doing.

The ground, having been laid evenly, must be left until dry enough to permit of the use of the scraper, by which the lights may be put in so as to imitate the stroke of the white crayon as closely as the circumstances will allow. Thanks to the grain underlying the varnish, this may be accomplished more easily than would at first sight appear possible. The scraper must be quite sharp, and should be held lightly in the hand, so as to obtain the necessary freedom in manipulating it.

The scraping having been done, the stone will require to be etched, in order to preserve the lights. The strength of acid necessary for this purpose will depend a good deal upon the thickness of the varnish. Though the exact strength cannot be stated, little difficulty will be experienced if the following expedient be resorted to: Select a portion of the tint for experiment that is to remain solid or of full color, and commencing with very dilute acid, try it upon that portion of the stone until, by the addition of more acid, the ground is attacked. Then by diluting the acid it will be brought gradually to such a condition that it will not attack the ground, but will be efficient in keeping the scraped parts open. The solid part that has been used for the acid test may be restored by rubbing upon it a little soap, which will effectually restore it to a full tint when rolled up. Any

of the methods described for etching chalk drawings may be used in this process, after which the stone may at once be rolled up by the lithographic roller in black ink, until the lights become clean and the dark parts quite solid. It may, previous to the rolling-up in black, be washed with a mixture of turpentine and oil.

After rolling up in black, if the tint is found to be satisfactory, it may be dusted with very finely ground rosin, and acidulated until a perceptible depth is reached. In this way relief will be imparted to those portions representing white chalk when the tint is printed in its proper color on soft paper.

Tints of Several Gradations.—Any of the methods employed in making drawings on stone may be used for the purpose of producing tints of various gradations, and are, in fact, so used where exactness and definition are essential in the practice of chromo-lithography. The method about to be described is, however, best adapted when two or three tints are required to be added to a drawing in black, or in the broader tinted effects in landscapes, etc., in colors.

The stone must have a sharp grain, as in the last-described method, but as this is a more complicated one, special attention is requisite to the subject of set-offs. If an ink which will permit of a black set-off being seen through it be used for rubbing in the ground, as described further on, such set-off may be made with a good drying ink and allowed a day or two to dry. If, however, the ground be too dark, or time cannot be allowed for the set-off to dry properly, the parts of the stone required to be defined in the various gradations are usually scratched

with a sharp point through the lines of the set-off. Sometimes a very fine gum outline will be found preferable, or common black writing ink, if not too gummy, may be used for a dark outline. The white parts should then be determined upon and stopped out with gum and acid, and the stone, when dry, will be ready to receive the ground, which, however, must not be laid in with the roller, as in the last method, but as follows:

Set the stone before a fire, and get it hot equally all over. Now rub over its surface a piece of rubbing-in ink, and continue rubbing until the grain of the stone is filled in.

This rubbing-in ink may be obtained of the dealers, but as its composition is not of any great importance, most printers who are conversant with the process described above have their own favorite recipe. Beeswax alone is a very good substance for this purpose, but is better when made dark by the addition of some black pigment. Tallow may be added to the beeswax to make it softer and more easy to rub in on a moderately hot stone. Wax, tallow and cuttings of lithographic chalks also make a very good ink, the latter ingredient rendering it sufficiently black to enable the artist to see the effect of his scraping. These different compositions will be found to vary in their power of resisting acids, and we would consequently recommend the student to keep to one kind as soon as he finds it to answer the purpose, as he will thus be able to know what degree of etching he has to give to obtain any wished-for effect.

Experience will soon determine the degree of heat necessary for this operation, and it will vary according to

the nature of the rubbing-in ink. The superfluous ink is next to be removed by rubbing the face of the stone with a large piece of an old coat or other woolen fabric, changing the dirty part of the cloth for a clean one as may be necessary, and continuing until a perfectly even surface is obtained.

The stone, having become cool, may be washed with water to free it from the gum, so that the effect of the scraping may be more distinctly seen. This washing should now be done.

The inks we have described will permit of washing, but it is quite possible that one bought from the dealer in these materials may have so much soap in its composition as to render washing a dangerous operation; if so, it must be deferred until the tint has been once etched, but the *scraping* must be done previously.

The next thing to be determined is how many gradations of tint are required. For many purposes what is called full-and-half tint will be sufficient in conjunction with the scraping; it will do very well for ordinary fine-weather clouds, and is thus performed: After the scraping is done the parts intended to be full tint must be filled in with thick litho. ink, Brunswick black or copal varnish. It must be observed, however, that gradation between full and half tint may be attempted by the use of crayon laid on in the usual way, or Lemercier's stumping crayon, applied with the stump; but it must not be relied upon for producing the same effect after etching as is seen upon the stone. The margin and any broad white parts should also be covered with varnish, but not with litho. ink, which might penetrate the gum. The reason for so cover-

ing the margin is this: In the process of etching it will be found that the acid will recede from the edges of the tint, when there is a space of clear stone alongside it; consequently, such part of the tint is less acted upon, and prints darker than is required. If, however, such margin or other broad spaces be stopped out with a resisting varnish, the etching fluid will act more equably where it is required.

Tint-printing requires considerable experience and judgment. We may point out, as a general rule, that thin inks produce soft and wash-like tints, while stiff inks make the tints look more granular, and keep them in better condition while being printed. The lighter the tint is, the less easily can any defects be seen while they are being inked; but as light tints show the grain of the stone less distinctly than darker ones, it follows that stronger ink may be employed for the purpose of keeping the work clear. The color which needs most attention in this respect is yellow, which, on account of its lightness, is very apt to catch unobserved upon what should be the clean parts of the stone.

Washing Out Tints After Their First Preparation.— Care must be taken when washing out these tints if they have been stopped out with varnish made with turpentine. This solvent sometimes dissolves the ink used in laying the ground, and when the whole comes to be washed out with turpentine alone there is a likelihood of those parts of the tint not rolling up properly. This difficulty may easily be overcome by adding a little grease or oil of any kind to the turpentine used for washing out. After it has been once successfully inked in, tur-

pentine alone will usually be sufficient for washing out when removing the black ink to prepare for color. It must be borne in mind, however, that the mass of ink is so much greasy matter, and that when the dirty rag is changed for a cleaner one the quantity of grease is reduced with the next dose of turpentine.

The etching of these tints may be facilitated by the following operation: After the ground has been rubbed in, the gum used in stopping out must be thoroughly washed away and the stone dried. Set the stone in the press; lay upon it a sheet of paper of the thinnest and evenest substance procurable; upon this place a thin, smooth sheet of metal, such as is used for paper-glazing, and pass the whole through the press with a light, even pressure. The result will be that some of the ink will be removed from the upper points of the grain, leaving them in a better condition for the action of the acid.

Another method of producing a tint of several gradations with one etching: Any kind of set-off is first put down, so that the margin may be neatly and accurately gummed out. An impression is then taken upon tracing paper, or an impression upon ordinary paper is laid upon gray or somewhat dark paper and passed through the press so as to get a reversed key. If the corners of the margin be cut away exactly to the corners of the work, the impression may be accurately registered to the corresponding corners upon the stone and fastened to the margin, after the tint has been rubbed in with a soft ink. The tracing-paper impression, being turned over, will give the same results as the reversed impression upon the gray paper, and be equivalent to a set-off. If the desired

effect be now worked up with hard white crayon upon the paper, a proportionate amount of ink will be removed from the stone by the back of the paper.

One of the modes invented by Senefelder for producing India ink effects may also be employed for tint-making. A grained stone is first prepared with soap-water, which, when dry, is removed from the surface by washing with turpentine. The drawing is then made with washes of hard ink, containing a considerable proportion of soap. When completed and dry, the drawing must be rubbed over with a piece of flannel or other woolen cloth, so as to better expose the points of the grain to the action of the acid. Even the deepest shades previously laid will now be assailable; therefore, those parts which are to remain quite black must be laid in after the rubbing in has been finished. We think that the principal difficulty of this process consists in making the drawing. In practice it is found that the working of the lithographic ink on stone is so different to that of India ink on paper that other modes are resorted to in preference, even though they may be more laborious. When these drawings are completed they are best etched by surrounding the work with banking wax and pouring very dilute acid on the work, letting it remain on until bubbles of gas arise and attach themselves to the points of the grain. When the work is thus covered with gas-bubbles the acid is poured off, and these bubbles are thereby broken up. Another application of dilute acid is made, and the same action permitted to go on again. This is repeated until sufficient etching has been given, according to the subject.

Stumped-In Tints.—The set-off having been made on a sharp, finely grained stone, the high lights are to be stopped out with gum. Take a piece of soft wash-leather, strain it over the finger, and charge it with some of Lemercier's lithographic stumping crayon. Now go all over the stone for the light tint, with a light circular motion of the wash-leather, recharging it with the stumping crayon as often as necessary. The nature of the work will determine the precise method to be employed. Rolled wash-leather stumps may be used to lay in forms of clouds, etc. The scraper may be used to give precision in lights, and the crayon or ink for the deepest parts. If it be desired to imitate repeated flat washes of color, it may be done in the following manner:

The light tint having been laid as before described. the parts that are to remain of that tint are to be stopped out with thin gum to which a little ox-gall has been added. When this is dry the stumping crayon is again used to give the next gradation, which is in turn stopped out to preserve it.

Tints Formed by Transferring Lines, Etc.—The same system used in transferring lines in connection with ink-work may be pursued in getting light tints in color-work with good effect, and for a simple light tint in conjunction with full color the mode there described will be all that is necessary. These lines from plate, however, may be used very effectively, and four distinct gradations obtained with one printing, by following the instructions about to be given:

The plate to be used should, of itself, form what may be denominated a quarter-tint. The parts which are to

be of full strength are drawn in with litho. ink, and those which are to be white are to be gummed out. The lines from the copper or steel plate are then to be transferred, in a horizontal direction. When this first transfer is complete the stone must be washed as clean as water will make it. It must then be prepared, either by an acid, such as acetic acid, or a salt, such as the mixture of alum and sal ammoniac.

Tints from Stippled Plates.—In stipple or similar color-work upon polished stones, where it is small, a sky or other effect may be chalked upon this paper and transferred in. Where the surface is large, the plate itself may be inked in, as for copper-plate transfers, and transferred to produce a tint. This method may be also further utilized by chalking upon the transfer and adding ink to produce darker effects, the lights being scraped out previous to transferring. This, however, is scarcely applicable where there is more than one color in the sky, as it then becomes necessary to work to the set-off on the stone so as to secure register. In the pursuit of the art it is almost imperatively necessary to be practically acquainted with all these methods, so as to be able to employ the one best suited to the work in hand.

CHAPTER XV.

Chromo-Lithography—Printing—Treatment of Colors—Dryers.

THE two last chapters treated principally of the different modes of putting the chromo-lithographic subject upon the stones and the means of securing their proper register. We come now to the printing of these stones, and shall first of all refer to the qualities of the colors without entering into the question of their harmonies, a subject which has been fully treated by more competent authors.

The pigments employed in lithography embrace nearly the whole of those produced by the color-makers, but they are not all equally suitable for lithographic printing. The two necessary qualities are permanency and ease of working, but these are possessed in quite different degrees by the different pigments.* Fortunately, nearly all the most trustworthy pigments can be successfully used in printing, but some of the most brilliant ones are not only unpleasant in use but fugitive in color. This question of permanency of color is either much misunderstood or not sufficiently attended to by many among the color printers

* The following inexpensive works may be consulted with advantage:—"Hints on Color and Printing in Colors," by P. B. Watt. London: Wyman & Sons. "Color," by Professor Church. Cassell, Petter, & Galpin. "The Principles of Coloring in Painting," by Charles Martel. Windsor & Newton.

of the present day. The demand for cheap inks is probably one great reason why so many of our productions fade so rapidly, and it is not in lithography alone, but in typographic block-printing as well, that this defect frequently exhibits itself.

There are three enemies to permanency of color that are found to act inimically on color prints. They are light, impure air, and the chemical action of one color upon another. We shall mention the pigments which are more or less affected by the first two causes, but detailed treatment of the third will be beyond the space we can afford, demanding as it does almost a treatise to itself. The following are the pigments which are most suitable for making lithographic inks, but the list does not comprise all that may be employed:

Reds—Vermilion, Indian red, red ochre, Venetian red, madder lakes, crimson and scarlet lakes, red lead, chrome lead.

Yellows—Yellow ochre, raw sienna, cadmium yellow, yellow lake, chrome yellow, mineral yellow.

Browns—Raw and burnt umber, Vandyke brown.

Oranges—Burnt sienna, York brown, mineral orange, orpiment, orange lead, chrome orange, laque minerale.

Blues—Ultramarine (dusting), cobalt, oriental, Chinese and Prussian blues.

Greens—Scheele's greens, green lake.

Purples—Mauve ink, mixtures of blues with reds.

The following selection of pigments may be regarded as *permanent* under all the ordinary circumstances to which a chromo-lithograph is likely to be subjected:

Reds—Vermilion, Indian red, red ochre, Venetian red, madder lakes.

Whites—Zinc white, baryta white.

Browns—Raw and burnt umber.

Oranges—Burnt sienna, York brown, mineral orange.

Blues—Ultramarine, cobalt.

Yellows—Yellow ochre, raw sienna, cadmium yellow.

The following colors may be used, in addition to the above, *when they are more or less protected from light,* and are therefore useful in book illustrations:

Reds—Crimson lake, scarlet lake.

Yellow—Yellow lake.

Orange—Orpiment.

Purples—Mauve ink, purple lake.

Blues—Oriental blue, Chinese blue, Prussian blue.

The following colors withstand light and pure air, but are liable to injury by *damp, shade and impure air:*

Reds—Red lead, chrome lead.

Oranges—Orange red, chrome orange, laque minerale.

Yellows—Chrome yellows, mineral yellow.

Blues—Cobalt blues.

Greens—Mineral green or green lake, Scheele's green.

Whites—Flake-white and other lead-whites.

The following pigments *should not be used with flake-white* or other *lead colors:* Indian yellow, yellow lake, Italian pink, orpiment, red lead, crimson and other similar lakes, carmine and indigo.

Colors which should not be used with others *containing iron:* Silver white, King's yellow, patent yellow, Chinese yellow, carmine, scarlet lake, blue verditer.

From the following pigments may be selected the colors for *finishing printings,* on account of their transparency: Raw sienna, Indian yellow, Italian pink, yellow

lake, madder lakes, crimson and scarlet lakes, cobalt, Chinese and Prussian blues, Mars orange, madder purple and purple lake, Vandyke brown and burnt umber. Black ink, or other opaque dark color, is used for finishing, on account of its cutting-up quality.

Treatment of Colors.—The proper management of colors is only to be acquired by study, experience and observation. We have previously explained the manner of grinding colors, but in this place there are some special details of the subject which ought to be mentioned.

Colors differ in the manner of their grinding. Some, such as carmine, emerald green and ultramarine, can scarcely be used at all for litho. printing inks, and require to be dusted upon lighter inks of suitable color. Some others, like the cochineal lakes, print better when first ground in water or turpentine, though their brilliancy is thereby somewhat reduced.

Some pigments may be ground more easily than others, some being soft and unctuous, while others are hard and gritty. Much, however, depends upon the previous preparation of the pigment by the manufacturer. Thus, there are natural colors, like York brown, which are ground easily, while others like Vandyke brown, are difficult to reduce to the necessary fineness. These and other colors may be bought after having been ground by steam power, by which much time is saved. Several of the large country color printers who employ many machines on chromo work have small ink-mills, by which they grind their own inks. In this there is the advantage of knowing precisely of what pigments the inks are made.

Dryers.—We have spoken in the last paragraph of certain colors which dry too readily. Some colors, on

the other hand, have the opposite quality, and dry with difficulty.

What is known as "patent dryers" is a preparation of litharge, ready ground in oil, and it may be added to those colors for which it is suitable. "Patent dry dryers" is a white powder, which requires very little grinding to incorporate it with the ink. *Acetate of lead,* or, as it is commonly called, *sugar of lead,* is one of the most useful dryers, and does not injure the brilliancy of the most delicate colors. *Sulphate of zinc,* or *white vitriol,* or *white copperas,* as it is variously called, is less powerful than lead acetate, but better suited for some colors. These two substances should not be used together, as if so used they would probably decompose each other, producing *sulphate of lead* (which is an opaque white), and *acetate of zinc,* which is a bad dryer. Japanner's *gold size* is oil boiled upon *litharge,* and may be used as a dryer for lakes. These various dryers properly used will generally completely answer the printer's purpose. Too much of the dryers defeats the object of their application and renders the inks saponaceous.

The following may be taken as good rules for the general use of dryers:

First. Not to employ them too freely, as they then retard drying.

Second. Not to use them in inks which dry fairly by themselves.

Third. Not to add them to the ink too long before it is used, which would make them "livery."

Fourth. Not to use more than one dryer at a time.

Fifth. Not to use secret mixtures recommended by

others, but those simple dryers with which you are acquainted.

As dryers we may use oil boiled upon manganese, or verdigris, in a similar manner to that boiled on litharge. These will do for dark colors. Some of the fast-drying pigments may also be used as additions to dark colors, such as verdigris, or *acetate of copper,* red lead, massicot and manganese-brown.

Ink for Tints.—Tinting inks are those which are employed to produce light gradations of color, such as those found in skies, clouds, flesh, etc. They are produced in two ways, each of which has its own advantages and defects.

The reader will easily understand that the greater the quantity of varnish used, in proportion to the color, the paler and more transparent will be the resulting tint when printed. In this state it should be used in nearly all cases where the under printing is intended to show through it. There are occasions, however, when it is desirable to have the tint of an opaque character. It is then usual to grind some kind of white pigment with the ink, and as the whites made from lead possess the best covering qualities, they are frequently employed for this purpose.

The use of white in tinting ink should be confined to the early printings. Whites are, indeed, very useful in obtaining effects in imitation of water-color printing. Another advantage of the use of white in the ink is that, on account of its requiring to be printed in greater body, its effect when on the stone is more easily seen than that of light transparent colors.

In the production of chromos many of our best

printers almost entirely discard the use of white, which they consider inimical to softness and brilliancy.

The kind of varnish to be used for tinting ink will depend upon the nature of the tint to be printed. If it be quite a plain tint, the varnish may be of the thinnest, but if it be an etched tint, or one which possesses much fine work in it, the varnish should be stronger.

Printing Tints.—After what has been said of the nature of tint ink in the last paragraph, little remains to be told as to the method of printing with it, for all the principles previously laid down in regard to printing in black apply to the printing in colors or tints. A great help to printing tints well and quickly is the use of proper rollers. These should be quite even on the face, of a fine texture, and the seam quite invisible. It will save much time, and add to the probability of clean work, if five rollers be employed, one each for the blues, reds and yellows, one for light tints, and another for the dark, broken colors.

Especial attention must be paid to the thorough cleaning of the rollers, both by scraping and washing with turpentine.

Many attempts have from time to time been made to make a roller applicable to lithography which should possess the qualities of good surface, elasticity and impermeability to printing ink. Those made of treacle and glue, which are used by letterpress printers for block or type printing, possess these qualities, but in lithography the water used in damping the stone rapidly destroys the surface of such a roller, so that eventually it will not hold the ink. Rollers formed principally of india-rubber pos-

sess all the good qualities of the glazed roller, while they are permanently soft and elastic on the face, and possess a certain amount of nap, in which the ordinary glazed roller is deficient. They are in use by some of the best houses in the trade, and are highly appreciated.

Oleographs.—The distinction between oleographs and chromo-lithographs is only one of name, the real difference consisting merely in making the print imitate an oil painting as much as possible. To this end the finished print is mounted on canvas, sized and varnished. Sometimes the imitation of canvas is produced in the press by the finished print being pressed in close contact with what is technically known as a "roughing stone."

Roughing.—Some of the most successful copies produced by chromo-lithography have been those of water-color paintings. Among the advantages claimed for water-color paintings are the even granularity of the paper and the absence of glaze. There are no patches of thick color to suggest that it is paint we are looking at, and this grain of the paper is useful in preserving those aerial effects in which water-color paintings excel all others. It was soon seen that the lithographic imitation was wanting in some important particulars, viz., that its surface was too smooth, and lacked the atmosphere seen in the original. The defect once observed, the remedy was obvious—to give the picture the necessary granulation by subjecting it to pressure on a rough stone.

The roughing-stone may be surfaced by using very coarse sand under the levigator; but if this is not thought to be rough enough, it may be intensified in the following or a similar manner: After the stone is dry it may be

rolled over with a glazed or letterpress roller until all the points of the grain are covered with ink, the bottom of the grain remaining bare. Brunswick black may be used instead of ink; but if the latter is adopted, the stone may be wetted, rolled up and dusted with rosin. These points will now resist the action of weak nitric acid, so that the interstices may be bitten until the desired effect is attained.

A similar result may be obtained by applying stumping chalk to the tips of the grain with wash leather, subsequently rolling it up and treating it as before mentioned.

If it be desired to have an exact imitation of rough drawing paper, the latter may be sent to the stereotyper, who will furnish a cast of it which may be used instead of the stone. In the same manner a cast may be taken from a piece of canvas, if it be first well sized with starch.

Chromo Transfer Prints or Decalcomanie.—These are chromographs which are intended to be transferred from the paper on which they are printed to some other surface.

Take some thin plate-paper, and brush it over with flour or starch paste. When this is dry the paper may be again treated with a strong solution of gum, or gum and starch. When again dry it is to be well rolled. The printing is done on this paper, but the colors are worked in the reverse order to what they would be in ordinary work. The transparent colors must be printed first, and the opaque ones last, so that when transferred the two will stand in their proper order. If these transfers are intended for being transferred to glass, the natural order must be observed, because they will be seen *through* it.

The mode in which these pictures are transferred is very simple. Either the surface they have to be applied

to or the back of the print is brushed with a varnish such as copal. When this becomes tacky the two are rubbed into close contact and allowed to dry. If the paper now be sponged upon the back, it may be pulled off after soaking for a few seconds, leaving the printing firmly attached to the other surface.

Multiplication of Color Subjects by Transferring.—No doubt most of our readers have seen sheets of chromos in which the subjects are repeated so as to make a sheet-full. These are not drawn so many times, but are transferred. The ordinary process of transferring will not do for this purpose. To insure success, means must be taken to prevent the expansion of the work.

There are two methods in use for this purpose. In the first what is called "unstretchable varnish" transfer paper is used. Register corners are put to each subject in each color. In pulling the transfer care must be taken to have the stone dry for each impression. The principal color, or the key, is printed upon paper that has been well rolled, or it may be printed upon a thin sheet of zinc. The transfers are cut accurately at the register corners, and are gummed or pasted exactly to the corresponding corners on the sheet of paper or zinc. The stone having been adjusted in the press, the sheet is laid upon it and pulled through *once* under good pressure, when it will be found to have absorbed most of the ink from the pieces of transfer paper. It is afterward treated as an ordinary transfer.

When paper is used as the medium of carrying the transfers it will be found a great convenience to have a framed piece of thick glass which can be set nearly up-

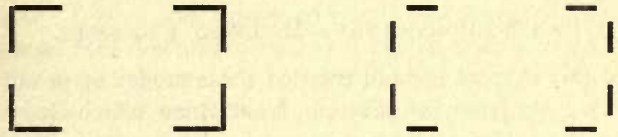
right or sloped to any convenient angle. The paper key is secured to the glass by pasting at its corners. The glass being set against the light of a window, a piece of white paper or other reflecting surface is used to throw the light through the glass. The register marks can be plainly seen through the transfers, which may thus be placed in position with great accuracy. This instrument is called the "sticking-up" frame.

The second method is perhaps used more extensively than the one just described, on account of its possessing some advantages peculiarly its own. The transfer paper is transparent or nearly so, being prepared on one side with a transfer composition which will easily adhere to a wet stone. Paper coated with a solution of gum arabic will answer.

The transfers are pulled on this paper and trimmed round, but not so closely as in the other method, because to do so would be unnecessary. They are now fitted over the key (which can be sufficiently seen through them to insure accurate adjustment), and the corners gummed to keep the transfers in their places. The gum being dry, they are ready to be transferred. Zinc may also be used to attach the transfers to in this, as in the other method, but the cement used must not get dry, because it is important that the transfers shall adhere to the stone instead of the zinc. They may be temporarily attached to the zinc by means of a little stiff varnish, golden syrup and strong gum, or other similar adhesive matter that will hold them in place, and yet allow them to separate from the zinc when necessary. Thus when they are transferred to the damp stone they must adhere to it sufficiently for them to be pulled away from the zinc plate.

If opaque paper be used, the transfers may be accurately set up to register in the following simple manner:

Corners are drawn in the key-stone, which are inked over in each succeeding color. In each label of the stone



first made up the corners are allowed to remain; but in attaching the transfers of the other colors part of each corner, the extreme angle, is to be cut away, so that when one is laid over the other it can be seen plainly whether the lines correspond.

CHAPTER XVI.

Photo-Lithography—Modified Processes.

IN this chapter we will treat of those modes of producing subjects for printing from stone which depend upon the action of light, and are known by the name of photo-lithography.

In discussing this subject we do not intend to describe the various general photographic processes, as there are many cheap and good treatises on the subject already published. Most of these photographic manuals, however, address themselves to portrait and landscape work, and we shall briefly point out the specialties of certain instruments which are best adapted to the technical purpose in view. Before doing so, however, we must give our readers an idea of the complete process of photography, so as to enable them to understand the details afterward to be presented.

Photo-lithography is a method of producing a copy of a print or drawing in line of the same or altered dimensions. This print is of such a nature that it can be multiplied from stone or zinc at the ordinary lithographic press or machine. It is necessary that the subject to be copied should consist of visible lines or dots to insure distinctness in the reproduction. The copying is done by photography upon glass. What is technically called a "negative" is first of all produced. If this negative is viewed by trans-

mitted light, it will be seen that those parts which correspond to the white ground of the original drawing or engraving are more or less dark and opaque, while the copy of the drawing itself consists of transparent lines.

This negative is put into a photographic printing or pressure frame, and a piece of chemically prepared paper is placed face downward upon it, in contact with that side of the glass upon which the picture has been produced. The back is then secured in its place and the glass side exposed to the light. After it has been sufficiently exposed it is carried into a dark room and covered all over with transfer ink. Upon subsequently washing it the transfer ink will be removed from those parts upon which the light could not act; that is to say, upon the parts corresponding to the white paper; but it adheres to those parts upon which the light has acted, namely, the lines. We have now a photographic transfer, which may be applied to a stone or zinc plate and printed from in the usual manner.

After this general outline of the process it is necessary to explain the chemical nature of the paper as it was exposed to light under the negative. Certain salts of the metal chromium, notably the bichromates of potash and ammonia, possess the property of extreme sensitiveness to light when combined with various organic matters, such as gelatine, albumen, gum, etc. Being rich in oxygen, they quickly yield up some of it to the organic substance under the influence of light, and render it insoluble in water.

Not only is the organic substance rendered insoluble, but it is to a certain extent resistive of water, so that the ink applied holds to it tenaciously, while the part not so

acted upon by light may with proper care be washed away. This effect also occurs spontaneously even in the dark when the paper is kept for some time, so that it is best to prepare it as wanted. Further, the solution itself will keep for a considerable period without undergoing a similar change; it is only when it becomes dry that the change takes place. This is a peculiarity which in practice is found to be very serviceable. We thus perceive that the prepared paper must be dry, not only to prevent staining the negative, but in order to be properly influenced by the light. We are enabled to coat the paper in ordinary daylight, but it must be dried in the dark.

Let us now glance at the instruments and other requisites for this process.

The Lens.—This is the optical arrangement which produces the image on the sensitive glass plate. The ordinary lenses used for taking portraits and landscapes are not adapted for this purpose. It is necessary to have lenses that will give in the negative straight marginal lines corresponding to or reproductive of the similar lines in the original. Suppose, for instance, a very large map is to be copied by this process. It will have to be divided into rectangular portions, each one of which must be suitable for copying to the required size, according to the lens used. It is imperative that the marginal lines of each negative be straight, or they will not join each other. Now, the picture produced by the ordinary portrait and landscape combination is somewhat barrel-shaped on its edges, and it is obvious that these would not correctly join together. A map is a crucial test, because not only is accuracy imperative, but any defect is at once visible.

We cannot divide it into sections without cutting through portions, which would at once show any error when the sections came to be put together.

The Camera.—This is the dark box in which the plate is exposed while the subject is being copied. We shall not describe it, because that will be done in the work on photography that may be selected as a guide-book. As it is not every lens that will suit our purpose, so it is not every camera which can be rendered available.

The Negative.—A negative for portraiture or landscape is best when it is more or less translucent in every part, but that for our present purpose should be uniformly dense or opaque all over, with the exception of the lines forming the picture. These should be quite transparent. It is not easy, and not always practicable, at first, to obtain these qualities, but they should be the aim of the worker, because after a little experience it is comparatively easy to produce a good result in photo-lithography with a suitable negative.

Preparation of the Sensitive Transfer Paper.—It has been stated that gum, albumen and gelatine are the principal organic substances employed in photo-lithography. The chemical differences between the bichromates of ammonia and potash are in this connection so slight that it will be sufficient to select one of them—say, the bichromate of potash. Gelatine, albumen or gum may be used separately or in conjunction, but to simplify the manipulation we shall confine our attention at first to the gelatine.

Set 1 oz. of the purest gelatine to soak in as much water as will cover it. While this is soaking dissolve

1 oz. of bichromate of potash in 5 oz. of water, and filter. After the gelatine has swollen pour upon it sufficient boiling water to make 11 ounces, and add the 5 oz. of bichromate solution to it. If put away in a cool place this will keep good for a considerable time—much longer than will the paper that is afterward prepared.

When used, this bichromatized gelatine should be poured into a dish, and the temperature raised to about 100 deg. Fahr. Some positive photographic or other fine-woven paper is taken by the corners and lowered upon it in such a manner as to exclude air-bubbles. Let it remain for two minutes, and then hang it up by one corner to dry in a dark room. When dry it may be again floated upon the same solution to insure it being uniformly coated, and hung up by the opposite corner to dry again.

A piece of this paper is placed in the pressure frame. It will be found upon examination that the back of the frame is divided into two parts by hinges, so that one compartment may be lifted and the progress of the action of light watched from time to time. The exposure may be for a minute or an hour, and will depend upon the intensity of the light and the quality of the negative.

Inking and Development of the Transfer.—A stone or metal plate having been adjusted for pressure in the press, is now inked up in transfer ink. The photographic print is taken out of its frame, laid face downward upon the stone and pulled through the press, by which it is uniformly covered with transfer ink. It is now laid with its back upon water warmed to the temperature of 100 deg. After soaking for a few minutes it is laid upon a slab and the inked side of the paper sponged with gum-water

until the picture becomes quite clean, after which it is washed repeatedly by pouring warm water over it. When dry it is ready for transferring.

Transferring.—As a basis upon which to transfer the print we may use either stone or zinc. For all ordinary work we have found stone to answer every requirement.

The transfer is placed in the damping book until it becomes limp; it is then pulled through the press upon the stone or zinc plate.

When transferred the subject is treated exactly as if it were an ordinary transfer from stone.

A Modified Process.—Some of the most successful operators use an addition of albumen to the sensitizing solution. The most available source of albumen is the whites of eggs. The white being carefully separated from the yolk, is beaten up until it becomes entirely a froth. It is set aside, when the chief part recovers the liquid form, becomes very limpid, and may be filtered, which before would have been impossible. If only the white of one egg be operated upon, an equal quantity of water may be added to it, so as to render it more easily beaten.

A little albumen having been mixed with sensitized gelatine solution, the paper is prepared as before; but care must be taken that the solution is not heated enough to produce coagulation of the albumen, which happens at a temperature above 140 deg. or 160 deg.

This paper is treated precisely as the other, so far as exposure and inking are concerned, but it must be floated inky side upward on nearly boiling water.

Lichtdruk or Albertype.—The inventor of this process, Herr Albert, substituted glass as the basis for the gela-

tine because it gave him the opportunity of hardening the film from the back by exposure to light. By a preliminary coating of bichromatized albumen, also hardened by exposure from the back, he was enabled to effect his purpose more completely, so that a large number of impressions could be produced of very great beauty, and hardly distinguishable at a little distance from silver prints from the same negative.

The Heliotype.—In this process the film of gelatine is made portable. A glass plate having the slightest possible film of wax upon it is leveled, and the mixture of gelatine and bichromate of potash, with a small quantity of chrome alum, is poured upon it to the thickness of cardboard. When this has dried hard the film can be removed from the glass and exposed under the negative in the same manner as a piece of paper. After exposure the soluble salt is washed out and the film again dried. For printing from, the film is secured to a metal plate by a solution of india rubber run around the edge. It is then treated precisely as the Albertype plate, but with this difference, that the inventor, Mr. Edwards, prefers an Albion or similar letterpress instead of the lithographic one.

CHAPTER XVII.

Tracings—Autographic Transfers—Reversing Transfers.

WITH a view to avoiding confusion in the treatment of our subject, we here refer to a few processes which do not frequently come within ordinary practice, but which nevertheless should be understood, on account of their occasional usefulness. Some of them might have been included in a previous chapter, but it has been thought best to allot them a separate one.

Tracing Photographs and Other Subjects of Indistinct Outline.—It often happens that the lithographer requires an outline tracing of a subject which, though tolerably clear in itself, becomes very confused when seen through the ordinary tracing paper. There are several methods of overcoming this difficulty, and are accurately described under the heading "Keystones" in Chapter XI.

Autographic Transfers by Turpentine.—The method of transferring by means of turpentine, described in the chapter on keystones, is capable of still wider application. Writings in lithographic ink, and recent impressions from stone and type on plain paper, may be transferred successfully in a similar manner; indeed, we much doubt whether they may not be more certainly and better executed by this method than by the Anastatic process.

Reversing Transfers.—Circumstances sometimes arise

in which the lithographer desires to reproduce automatically subjects which involve much labor when executed by hand. Of designs which are repeated, like some kinds of borders, a portion only may be drawn upon the stone or transfer paper, and be completed by taking retransfers of such portion, mounting them in the manner required upon a piece of paper, and transferring the whole to the stone, when any defects may be remedied by the methods we described when treating of *corrections*. It sometimes happens, however, that the design is of such a character as not to contain elements that are often repeated, but which require a duplicate in reverse, in regard to right and left. The design may be an ornamental one, involving much intricate drawing, and the artist may be desirous of avoiding the tracing, retracing and drawing that would be necessary to repeat the design for the other half of the border.

Transposition of Black and White.—It is sometimes desirable to be able to change dark letters, etc., on a light ground to light letters on a dark ground. This will be found of great advantage in some kinds of color printing, as in the instance of printing in bronze or silver on dark glazed paper.

First.—If the subject be a copper-plate engraving, the transfer ink or letterpress printing ink may be applied directly to its surface by means of a letterpress roller, using it lightly and with as little ink as will answer the purpose of transferring. The impression may be taken at the lithographic press, but instead of laying a soft material at the back of the transfer paper, a piece of very smooth cardboard should be used. If this is properly

done, there will be no difficulty in transferring it by one of the methods hereinbefore described.

Second.—In this system any subject that can be printed from a polished stone may be changed from a light ground to a dark one or *vice versa*. The subject having been protected by rosin, is to be acidulated until it stands perceptibly in relief, the thickness of the resinous coating being allowed for. Wash the ink, etc., away with turpentine, and the whole stone quite clean with water, using clean water, containing about one per cent of acid, for the final wash. The stone having become dry, cover the work to the extent desired for the ground with lithographic writing ink, which must be permitted to dry, when the whole may be rolled up in printing ink. This covering with lithographic ink may, if the operator wishes, be done after the etching operation, allowing the stone to dry. The work and the ground being now equally black, the ink has to be removed from the parts in relief, so that they may be reversed from black to white. Take a piece of snake-stone, making it quite flat by rubbing it upon the margin of the stone; then polish away the surface of the raised portion until the design becomes quite clear. If any part of the ground should be accidentally damaged, it must be touched up with lithographic ink to repair it. Gum the stone, dry, and roll up. It may be again rosined and etched, in the same way as before, if it is thought worth while, to reduce the parts in relief to the level of the ground. Many examples of this kind of work will be found among labels and show-cards—the uninitiated sometimes thinking they are printed in white, more especially when the sample has first been set up in type.

Third.—If an impression of the subject to be transposed be taken in a strong ink, it may be dusted over with finely powdered dry gum arabic or with dextrine, which may subsequently be placed in a damp place until it becomes sticky. In this state it may be laid face downward on a damp stone, and the gummy coating transferred to the stone. The margin may now be protected by gumming it round to the shape and drying it. If a roller with greasy ink be applied to the dry stone, it will be covered all over; but, on subsequently washing with water, the ink will come away where the stone was protected by the gummy covering transferred to it from the design.

Fourth.—At least partial success may be obtained by gumming the stone all over, drying it, washing it off, and again drying. The transfer in greasy ink is now to be made with care. A *very* weak etching water must next be applied to clear the stone of gum only, with the exception of that lying under the design. Dry again, and roll in with printing ink. If the stone be now damped and rolled in with very stiff ink, the parts of the design where the gum was not etched away will probably yield the ink of the transfer and become white, which may then be kept pure and open by another application of the etching water.

Fifth.—A process similar to the last is the following: Apply to the surface of the stone a solution of silicate of potash (commonly known as water-glass); make the transfer; dust with powder rosin, and remove the water-glass with a solution of alum; ink in, and proceed as before described.

Sixth.—*Transposition* may be effected by photo-

lithography. Take a clean piece of sensitized photo-lithographic paper, print the design upon it, and dust it with bronze powder to make it more impenetrable to the action of light; expose it to light, and treat it as a photographic transfer.

CHAPTER XVIII.

Labels—Bronzing—Gilding—Dusting—Dabbing Style.

MAKING Up Sheets of Labels, Etc.—Having determined upon the size of the sheet, or portion of the sheet, upon which it is proposed to print, it must be set out with a pair of dividers and ruled with pencil into as many squares, oblongs or other shapes as are to be printed at one time. By the method already described for taking transfers, pull as many transfers as required, taking notice that each one is good enough for the purpose. Trim them round neatly with a pair of scissors, a little within the size of the space marked on the paper, holding them in such a manner as not in any way to soil them. With a small stiff brush, or other convenient instrument, lay a little thick paste at the corners of the spaces marked, and carefully lay the transfer upon it, sliding it or shifting it into position by the help of a pointed penknife or any similar tool, using the same to press the transfer upon the pasted portion of the paper, so as to maintain it in place. See that it is right by the help of a straight-edge or parallel ruler, and proceed to the next transfer, and so on until all are done. When the pieces to be handled are very small, and have comparatively no margin, a pair of spring forceps, such as are used by watchmakers, will

be found very convenient in laying the little pieces in position.

In printing labels, every care must be taken in laying the sheet exactly to the mark, so that when carefully "knocked up" they may be exactly over each other. Sometimes the sheet has a cross or other mark printed at each end of it, which forms a guide to *thread* the sheets on two fine wires so as to get them in exact position.

The subject of "sticking up" colored labels was, however, treated of in the chapter devoted to chromo-lithography.

Bronzing, dusting and metaling, though more usually connected with color printing, will be described in this place, because they are often required unaccompanied by other colors.

The principle of the operation is very simple. An impression having been taken in a suitable adhesive ink, the bronze powder, silver or gold powder or dust color is applied to the wet ink by means of a pad of cotton wool, proportioned in size to the space to be covered, the superfluous powder being afterward removed by a soft cloth. When dry, much brilliancy may be added by rolling the impression on a finely polished metal plate.

In selecting a paper for this work regard must first of all be had to the purpose it is intended for. Writing paper answers very well because it is, when good, sufficiently sized as not to absorb the ink, and consequently enough of the ink is left upon the surface to retain the powder. Enameled and plate papers, having an absorbent ground, require more and stronger ink, so that at least some may remain on the surface.

Metal is, of course, applied differently to the powders. Dutch metal, Planier metal and Lane's metal may be brought to a suitable size by cutting through the *book* which holds it. The "laying on" is performed by a boy, who, removing the printed sheet to a convenient table, takes the book or part book of metal and lays it upon his left hand, with its joint toward the right; folding back the thin upper paper, he turns it under the book, thus exposing the leaf of metal. Taking the joint of the book between the thumb and finger of the right hand, he dextrously turns the sheet of metal over into its place on the printed sheet.

Real gold leaf is more difficult to handle, and, being so exceedingly thin, cannot be applied immediately after printing without the ink coming through; consequently, some time must be allowed to elapse between printing and gilding. The following is the method employed among gilders for applying the gold:

The tools are a cushion, tip, knife, dabber and softener. The cushion is a kind of wooden palette, about 9 by 6 inches, covered with smooth leather, stuffed with wool. The tip is a peculiar kind of brush, consisting of a thin line of badger's hair placed between two pieces of cardboard. The knife is similar in appearance to a palette-knife, and is made to cut along one edge only. The dabber is a tuft of cotton wool covered with some very thin silk. The softener is a long-haired brush, used to remove the superfluous gold.

The manipulation is as follows: The leaf of gold is first removed from the book, and laid upon the cushion by means of the knife, which alone must touch it. This

operation requires some experience in order that it may be properly performed. A gentle breathing under the leaf should so lift it as to permit of the knife being inserted under it. It is then lifted to the cushion, and flattened upon it by a similar emission of the breath. The gold is divided into strips, squares, or oblongs of suitable size for the work by the aid of the knife. The "tip" being drawn across the gilder's face or hair, and applied to the gold on the cushion, will lift it off. It may then be laid down on the prepared surface, and pressed gently into its place by the dabber. The whole being covered, it is set aside to dry, when the superfluous gold may be removed with the softener.

CHAPTER XIX.

Engraving on Stone.

WE have, in preceding chapters, described all the methods of producing lithographs in black and colors, in which the application of suitable ink or crayon to the surface of the stone has depended upon the manipulative skill and knowledge of form possessed by the artist. We have also described the various methods of transferring. There still remain to be treated of: *Engraving on Stone; Zincography,* as an application of the principles of lithography to printing from metal plates.

Engraving on Stone may be said to be connected with Lithography only by the chemical nature of the processes of printing, for in every other respect it is an entirely distinct mode of reproduction. We describe it in this place, however, in accordance with our plan of describing all those manual methods of Lithography in which color is used.

Engraving on stone is performed by cutting through a film of gum on or in the surface of the stone, and filling up the incised parts with a fatty ink. The printing is performed by a combination of the *dabbing* method of *copperplate* and the *damping* method of *lithographic* printing. Its advantages are—facility of production; accuracy of drawing; minuteness of detail; and clearness of impression. It is especially applicable to the reproduc-

tion of drawings by architects and civil and mechanical engineers when drawn to a small scale, and being performed by tools analogous to those employed by the architect and engineer themselves, errors due to freehand engraving or drawing can be entirely avoided.

The Tools.—These will not involve the lithographer in much extra expense, as he may make some of them himself. A diamond point is undoubtedly a very useful instrument, but it is expensive, and will cost as much, perhaps, as all the rest of the tools put together. Added to this, the beginner will find that it requires more practice to use it properly, and will not equal the precision of the steel points about to be described. From a tailors' trimming warehouse, or elsewhere, obtain a packet of strong needles, such as tailors use for sewing on buttons. From a toy-shop procure a common cane, about as thick as an ordinary lead pencil, and cut it into pieces about three and a-half or four inches long, rejecting the joints. These pieces should be cut square across, and a centre made with a point, as accurately as possible. Having obtained access to a vise, oil the needle and screw it up lightly in a horizontal direction, leaving about a quarter of an inch of it projecting; adjust the marked centre to the needle, hold the cane in a line with the needle, and push it on until it reaches the jaws of the vise; loosen the vise, screw up again, leaving a little more of the needle to project, and push the cane further on as before. Repeat this until nearly the whole of the needle is pushed into the cane. By adopting this method of supporting the needle in the vise, and pushing the cane onto it by degrees, we are enabled to effect our purpose

without breaking the needle. The cane may now be cut in the manner of a black-lead pencil, and the point may be shaped upon an Arkansas oilstone. Two conical points will be required, one long and tapering —almost as much as the original point of the needle— and the other more obtuse, for stronger lines. For shade lines, rub a flat side on the thicker part of the needle, and opposite to it make it round; this will make the point somewhat spoon-shape, and will be found to have the most useful form for ordinary work. The flat side is intended for the cutting part. When broad points are desired, the eye of the needle may be left projecting, instead of the point. A very good *tracing point* may be made by first breaking off about one-eighth of an inch of the needle, and then rubbing the broken part on the oilstone until it becomes round and without any angle which would scratch the paper. When found to be free from a tendency to scratch, it may be polished on a piece of leather covered with *crocus* or red oxide of iron. The *compasses* for engraving may be the best Lancashire spring dividers. Choose two of each of the sizes suitable for the work. Make one leg a smoothly-pointed cone— the smoother and more pointed it is the better, as it will then hold to its work and may be kept to a smaller centre hole than it would otherwise require. The other legs should be brought to a V shape and spoon shape respectively—the one for fine lines and the other for enlarging them into shade lines. For the smaller circles, a bow pencil with a stiff spring may be used, by substituting a steel point for the pencil. The points for the fine lines will require frequent sharpening in the

course of the work, and the oilstone must be constantly kept by the engraver's side. Very nice but expensive tools may be bought suitable for this class of work, but those just described will produce as good a quality of work as any.

Preparation of the Stone—The instructions usually given recommend a film of gum to be left upon the surface of the stone. This may be regarded as impossible in practice, for the film is certain to be thicker in some places than others, and if any mode of wiping has been used streaks will be left, over which the tool will partially jump and cause an uneven line when a fine one is attempted. Fortunately it is unnecessary to leave any gum *upon* the surface of the stone, all that is required being to fill the pores of the surface.

The stone should have as perfect a surface as possible. This being obtained, the stone must be dried and then gummed, and dried again. The gum must not be too thin, but it will be sufficiently thick if it dries upon the stone with a good gloss. If a little nitric acid be added to the gum the subsequent colored coating will be darker, but we think that the acid makes the stone harder to cut. If the stone has been warmed to dry the gum, it should be allowed to cool again. The stone is now to be covered with water, until all the gum has become dissolved; if the gum was previously strained, this dissolving will soon take place, but if the surface before moistening appeared rough, the hand had better be passed over to feel if any specks are left upon the stone. All the gum being now in a state of solution the stone must be placed in a slanting position, and plenty of water poured over to

wash off the gum. It is best not to rub the stone with the hand in this operation, because all the gum that is in the stone should be kept there. When the stone is dry it will be seen whether it has been sufficiently washed, by its presenting an even appearance; if it shines in streaks or patches it was not washed enough.

As in executing this style of work the lines are to show up light on a dark ground, it will be necessary to color its surface. For a black ground rub in some best Paris black until the ground is as dark as it can be made. The superfluous quantity must be removed with a soft cloth, or the tracing will not adhere. A red ground may be laid with *red chalk*, but be sure it is red chalk, as sometimes common Venetian red is substituted for it. Red chalk may be known by being smooth to the touch, and will polish when rubbed with the finger. Anything gritty or abrading must be avoided in laying grounds, and any scratches made in this operation will print.

The Tracing is best made on the black stone with paper prepared with chrome-yellow; but on the red stone it must be done with a paper covered on one side with Paris black, the ordinary black-lead paper not being sufficiently intense. Where great accuracy is required, the tracing may be neatly made in indian-ink, to which a little sugar, gum, and ox-gall have been added. The tracing having been made, is to be placed between damp sheets of paper for a few minutes, so that the ink may become slightly moist. When it is found to shine, it must be laid face downwards upon the stone and passed once through the press, when sufficient of the ink will have set off to enable the draughtsman to see his work very well.

The Engraving is so simple as to scarcely require description. It more resembles *etching* upon copper than engraving, but as the term etching is in lithography appropriated to the acidulation of the stone, usage has decided in favor of this mode being called engraving upon stone.

Let it be supposed that the subject to be engraved is a piece of machinery. Begin by determining the junction of the circular arcs with the straight lines, marking them with a pencil. As it is easier to join straight lines to circular arcs than the reverse, it is preferable, in most instances, to put the curves and circles in first, with the compasses. In doing this care must be taken that in making small circles the stationary leg of the compasses must be slightly longer than the moving one, or it will be apt to slip out when making the cut with the other leg. A sharp point, practice, and perseverance will enable the young engraver to do this without making a large centre hole. The circular portions having been executed, proceed to the straight lines by the help of the parallel rulers and a point not too fine. The facility with which thin lines may be made in this process generally tempts the student to employ them for outlining the subject. This is a mistake. They should be reserved for tinting and shading, especially in those parts that approach the light. When the whole has been firmly outlined, the compasses having the spoon-shaped point may be used for thickening the shade-lines, and a similar point, with the ruler for a guide, for strengthening the straight lines on the dark side.

The thin, taper, and very sharp point may now be used for the delicate lines of cylindrical and other shading

next the light, deepening the lines and exchanging the point for a broader tool as the darker portions are reached. A little practice, and the study of good examples will teach the student more of this work than can possibly be conveyed by writing.

The engraving having been completed, the centre-holes and other parts that must not be printed may be stopped out with a little acidulated gum-water, colored with any convenient pigment to enable it to be seen, and applied with the point of a sable pencil.

In working, avoid the condensation of the breath upon the stone, which may cause the gum in the stone to spread, and injure the more delicate lines. For a similar reason, guard the stone against the reception of any kind of mucilaginous matter.

Corrections in this kind of work must be avoided as far as possible. If it be imperative that any should be made during the progress of the work the part must be scraped out as smoothly as possible, and a new ground laid. This may be done by painting over the place neatly with the ordinary cake water-colors of any convenient tint. Red chalk or light red will do very well, but it must be understood that this, though an effectual "stop," will not be so pleasant to work upon as the original ground.

Let it be supposed that the work is finished; it must next be made ready for the printer. Take, upon a soft rag some thin printing ink, boiled oil, thin varnish, tallow, or in fact any kind of grease, and rub it into the lines forming the engraving. Though any of these substances will answer the purpose, yet, in practice, thin printing ink will be found most convenient, because it is always at hand,

and shows distinctly when the lines have been filled, which is very important. After being sure that every line has received some ink, remove the superfluity from the stone, and cover it with gum water.

Dabbers are used for inking instead of the rollers used in other styles of lithographic printing, and may be made as follows:—Take two pieces of wood of a convenient size for the stone to be printed, and about two inches thick; the underside, which must be quite flat, should be covered with the coarsest and thickest printers' blanket, strained over and tacked to the sides. Cover one of them in a similar way, and the other with a piece of fine blanket. Charge the coarse one well with thin ink, and the fine one with stiffer ink, and work it about on the slab until only a small quantity remains on its surface, and it will be fit for use, its office being to clear the stone of superfluous ink.

Printing.—Damp the stone as if for printing with the roller. Take the coarse dabber, well charged with thin ink, and apply it to the stone, with pressure from the shoulders, at the same time twisting it about until the stone is gone all over, when the dabber may be moved about in circular strokes to remove some of the superfluous ink. Putting this upon the ink-slab, take up the fine dabber, and use that in the circular, wiping manner only. The stone should now be pretty free from surface-ink, but a wipe with the damping cloth will finish it. If the stone becomes dry, it must again be wetted. After the dabbers have been got into working order, the fine one will effectually clear the stone without the subsequent use of the damping-cloth, and will do it more

clearly and effectually. The position of the printer should be such as to avoid all chance of any dirt falling from the ceiling, &c. The stone having been fully inked in, may be etched all over with weak etching-water, to finally remove any scum arising from the first inking, and afterwards gummed and dried.

The other essentials in printing are an elastic backing of printers' blanket as described under backing-sheets, and some damped paper. The printing, when all is in working order, may be carried on nearly as quickly as when using the roller. This will be understood when it is considered that in rolling, the surface of the roller in contact with the stone is successively lifted nearly perpendicularly, while the action of the fine dabber is almost exclusively a wiping one, and consequently leaves the ink in the lines.

CHAPTER XX.

Zincography. Its Principles—Scraping, Polishing, and Graining the Plates—Etching Recipes.

THIS important branch of the art will require only a short chapter, not because we underrate its merits, but because nearly all that has been said on drawing and printing on stone is equally applicable to working on metal plates, and consequently no necessity exists for extending the previous instructions on those points.

To those who desire extended information on this subject we recommend "Metal Plate Printing," published by The National Lithographer, New York. Price $2 the copy.

The Principles of Zincography are almost identical with those of lithography; and all ordinary styles of drawing may be performed upon zinc plates instead of on stone; the chief distinctions being that blacklead pencil-marks are apt to roll up in printing and that the two- and three-line lettering-gauges used by copperplate engravers may be used to mark direct upon the zinc. The materials used are the same, and the *mode* of printing is identical. Zinc plates have the advantage over large stones in being less in first cost, and being much more portable. Hence, they are used very extensively in many printing establish-

ments for a variety of work; the chief among which, it may be mentioned, are large plans and wall-advertisements. As neither ink, crayon, nor gum penetrates the zinc in the same manner as they do stone, the printing is more liable to accident, and requires great attention and skill on the part of the printer. One very marked difference between the zinc and stone, is that the former is subject to oxidation by contact with a moist atmosphere. For this reason, great care must be exercised in drying the plates off quickly after their preparation for drawing, and during the printing, to prevent the gummy preparation from being actually removed. The principle difference in the treatment of zinc plates by the printer, as compared with lithography, is the substitution of infusion of nutgalls for nitric and hydrochloric acid.

The theory in brief is that the drawing-ink and chalk form a metallic soap with the zinc plate. That this metallic soap has a great affinity for the zinc, so that the ink on the roller has little influence in pulling it off the plate. That the brown insoluble compound produced by the action of the nut-galls upon the plate, resists the printing-ink in a similar manner to the gum upon the stone. That these two opposite forces acting at the same time enable the printer to take a larger number of impressions than could possibly be the case if the only principle involved was that of the antipathy of grease and water.

Preparation of the Plates.—Zinc plates may be obtained ready polished or grained, of the dealers in lithographic materials; but as their subsequent preparation will in all probability have to be done at home, it will be as well to describe how they may be made ready for use

after being purchased, as they may sometimes have to be, of the metal dealer.

The zinc should be of the quality known as "best rolled and selected" It may be made into convenient sizes, by cutting a groove with a V-pointed chisel and hammer, in the direction required, but the cut must be quite straight across the whole. It is only necessary to cut about half through, when, by bringing the groove just over the edge of the table, the plate may be broken through by a sudden pressure on the part overhanging. The rough edges and corners may now be taken off with a file. Next, place it on a stone in the press, smoothest side uppermost, lay on a few sheets of paper, and pull through under heavy pressure. If the plate is found to be generally flat, it may still further be tested by drawing some pencil-lines across the plate with an HB lead pencil.

If the plate is fairly level, these lines will show on the paper when pulled through again. Convexity may be remedied by putting some blanket or soft paper on the stone, and pulling through the press with convex side up, with light pressure first, increasing it gently until the effect sought is obtained. If there should be any bruises in the plate, it may be sent to a coppersmith to remedy them.

The surface of the plate as it comes from the rolling-mill and as usually sold, is contaminated with scale and oxide, which must be cleared off. This is done by removing the surface of the zinc by means of a sharp scraper. The scraper used by the cabinetmaker will answer the purpose. It should be set in wood to get a convenient "grip" upon it, and may best be sharpened

by burnishing its edge, holding the burnisher in such a manner that it may be at a right angle to the scraper. This will, if properly done, produce a good scraping edge on each side. A tool that will answer still better may be made of an old smoothing-plane, the face of which has been somewhat removed at its front part, so as to bring the knife more upright. The knife must be ground at a very obtuse angle, so as to produce more of a scraping than a direct, cutting action. If the surface be removed by this tool, it will be done more evenly than by the other kind of scraper, because the wood of the plane prevents the knife sinking into any hollow places.

The plate having been scraped level all over, is to be treated as described for stone with pumice and snake-stone. However, unlike stone, all drawings on zinc, whether in ink or chalk, should be executed on a *grained* surface, to produce which proceed exactly as in graining a stone, substituting, however, a muller of zinc for one of stone. A plate about 24 by 18 inches will take a man an hour or more to grain because the zinc is less easily abraded than the stone. When the plate is done, wash it well, finish with hot water, and rear it up to dry off quickly, so as to prevent corrosion.

Printing from Zinc.—The drawing having been done precisely in the manner described in our chapters on drawing on stone, is handed to the printer, who etches it by applying the following mixture with a flat camel-hair brush:

Decoction of nut-galls.....	¾ pint
Solution of gum (thickness of cream)..	¼ pint
Solution phosphoric acid.....	3 drachms

letting it stay on half a minute or more, according to the nature of the work. To make the decoction of nut-galls, steep 4 oz. in 3 quarts of water for 24 hours, and then boil up and strain.

To make the solution of phosphoric acid, put some sticks of phosphorus into a bottle, taking care not to handle them with the fingers. Pour water upon them, but not quite sufficient to cover them. Close the bottle with a cork having a notch cut out of its side to admit air. Set the bottle aside for a few days, and the air will oxidize the phosphorus, making phosphoric acid, which will be dissolved by the water, and the solution in that time will be strong enough for use.

CHAPTER XXI.

Cylinder Press Printing—The Selection and Care of a Press—Inking and Damping Rollers—The Cylinder and Its Covering.

WE would especially direct the attention of the young printer to this branch of lithographic printing, because of its daily increasing importance, as machinery is now being generally acknowledged to be equal, under proper management, to the demands of very excellent work either in black or colors. Young men of intelligence whose minds are open to the reception of new ideas should pay great attention to this department of lithography, and should omit no opportunity to qualify themselves for any opening that may occur, because machinery has come so rapidly into use that the number of trained lithographic pressmen is very far below the actual requirements of the business. Hence, when a machine is newly introduced into an office, it is frequently found necessary to take a printer fresh from the hand-press and place him in the position of manager of a delicate and complicated piece of mechanism, with the principles of which he has no acquaintance whatever. To some men who have a mechanical aptitude the change is novel and agreeable, and provided that they have mastered the theory as well as

the practice of lithography, they probably soon develop into competent pressmen. On the other hand, the newly appointed pressman may have been chosen merely because he was a good hand-printer, and may have no mechanical proclivities. Such a man will most likely soon feel that he has had a responsibility placed upon him for which he is unsuited and will wish himself back at his hand press. To men placed in this position our instructions will, we hope, be of much use; while they may materially help others upon whom the necessity has not actually been imposed of adapting themselves to a novel and unaccustomed calling, yet who are animated by a desire—and a very honorable and worthy one—of understanding every branch and not merely one department of their business. A great living author and statesman has said that the true secret of "getting on" in the world is to be ready and qualified for an opportunity of advancement whenever that opportunity presents itself; and an exemplification of the truth of the remark is seen in every large establishment. The man who "gets on" is he who knows *something more* than his actual routine of work demands, and who is conscious that if his employer set him a little higher he would be capable of occupying the place. There are printers at press who think that because they have always made a living hitherto, and most probably will do the same in the future, the acquirement of any further technical knowledge is quite unnecessary and superfluous.

Having selected his cylinder press, the lithographer requires to know how to make the most of it, or, in other words, *how to keep it in the best working condition.* We

would point out, in the first place, that great and unceasing attention must be paid to oiling it and keeping it thoroughly clean. It should be the pride of every pressman not only that his press should *look* clean, but that it *be* clean. It is quite possible for it to look well and yet be really very dirty in the parts less in sight.

The temperature of the printing room should also be taken into consideration in the intelligent employment of lubricants. It is not saying too much to assert that a press will last many years longer when good oil is used than when bad is employed, so that there is no advantage in using the latter because it is low in price.

When a press is bought new it will not entail much trouble to preserve its good looks. When it is standing still, either from want of work, the setting of the stone, or scraping of the rollers, the boys should be instructed to rub up the bright parts and wipe away the superfluous oil. At least once a week this should be more thoroughly done, giving special attention to the working parts that are out of sight. As often as the work will allow, but at least once in three months, the press should be well cleaned in every part. Good oil will much facilitate these cleanings, and such attention as we are recommending will cause a machine to work much easier than a badly kept one.

As a rule, too, it may be truly said, that a well-kept press is *prima facie* evidence that good work is turned out from it and that a good man has control of it.

When a machine is newly erected it frequently happens that the vibration in working causes some of the nuts and screws to become loose; it is very essential,

therefore, that the pressman should try them occasionally until he finds from experience that they keep to their work.

The Inking Rollers.—These, when new, require a previous preparation of the same kind as hand-rollers. They may have rubbed into them either tallow, lard, or olive oil, which, after having saturated the skin, is to be well cleaned off by scraping. The rollers are next to be placed in the machine, which must be set running after they have received a supply of medium varnish. After running some hours the varnish must be scraped off, new supplied, and the machine put in motion again. It will be found, upon trying it with the palette knife, that the new leather has altered the character of the varnish, making it less liable to separate from the rollers. When this effect ceases to be produced the varnish may be thoroughly scraped off, its place supplied with printing ink, and the rollers tried first upon a heavy job.

The Damping Rollers.—If the stocks of these are made of iron, care should be taken to cover them with some waterproof substance, such as red lead paint, india-rubber varnish, oilcloth, American leather, or any other convenient material. They are then usually supplied with several folds of soft flannel, or some thick, soft felt, brought to join neatly without overlapping. The best thing of this class, however, is the fine india-rubber covered felt known by the name of *spongeo-piline*. The roller must be covered outside with some cotton or linen fabric. Canvas, a cotton material called swansdown, velveteen, and another named moleskin, are all in use, but we have a decided preference for the latter.

In regard to the general treatment of damping rollers,

they should be taken out of the machine every evening and set up on end, which will keep them in working condition better than leaving them in the machine. At this time they should be examined to see if they have accumulated any ink upon them, and if they have it should be at once removed by turpentine or benzoline.

The Cylinder and Its Covering.—With an ordinary blanket the cylinder will soon deteriorate, owing to the formation of rust, unless means be used to prevent it, and we recommend the following: Wash the surface of the iron with turpentine to remove grease, and then introduce some kind of gas arrangement by which the cylinder may be heated. The cylinder having a considerable weight, it will take a good while to get the metal warm, and a quantity of moisture will collect inside from the products of combustion, but that will be expelled as the iron gets hot. The surface may now be thinly and evenly painted with a mixture of red lead, drying oil, and Brunswick black or copal varnish. This will soon dry hard and prevent the moisture, which penetrates the blanket, attacking the iron.

A fine, but thick, or treble-milled printer's blanket may be used for covering the cylinder. For small machines a finer and thinner blanket may be used, because less variation in the surface of the stone may be expected when it is small. The more true the surface of the cylinder and stone are, the less necessity is there for thick blanket. If they were perfect, all that would be necessary would be something to prevent the stone and cylinder touching in those parts not covered by the paper; but as this perfection cannot be attained in practice, an elastic surface of appreciable thickness is required for the cylinder.

CHAPTER XXII.

PREPARATION OF THE STONE—PREPARATION OF THE WORK—ETCHING FOR MACHINE PRINTING—INKING—DISTRIBUTION—REFRESHENING THE ROLLER'S SURFACE—QUALITY OF INK—HOW TO REDUCE THE TENACITY OF INK—SETTING THE STONE.

HAVING selected his press, and got the rollers and the cylinder into proper order, the printer is ready to begin the actual working of it. The first thing to be attended to is the preparation of the stone.

The stone-grinder should remember, when preparing a stone for the machine, that the printer cannot adapt his cylinder to its surface, as is frequently done at hand-press, by means of a scraper. Every care, therefore, must be taken to have the stone true (back as well as front), more especially in the direction of the stone's length, because that is the way in which the cylinder is applied to it. Its two longer edges must also be not only well rounded, but stand fairly the test of the straight-edge along the rounded part. If this be not attended to the paper will be liable to crease. We know that the paper will sometimes crease from other causes, but this is one that is sometimes overlooked. The stone is easily tested by a straight-edge, which should hold a piece of ordinary post paper when applied at any part between it and the stone. Besides the general evenness of surface,

the stone should be well polished, for it then not only receives the drawing or transfer more perfectly, but is less liable in printing to catch the ink in those places which are intended to receive none.

Preparation of the Work.—Before a drawing or transfer is put upon the stone for machine printing, the size of the paper on which it is to be printed should be determined. The width of paper to be held by the gripper should then be ascertained, and a little more than that width should be allowed to project over the edge, so that the gripper shall not come in contact with the stone, which, if allowed to occur, would roughen it, remove the gum, and cause it at that part to accumulate ink from the rollers.

Etching for Cylinder Press Printing.—It is usual for cylinder press printers, previously to printing at the machine, to etch the work into relief, in the following manner: After cleaning the work sufficiently, ink it up strongly but clearly, and dust it with finely powdered resin or bronze powder, but preferably with resin; etch with dilute nitric acid, sufficiently tart to produce a pretty brisk effervescence; ink again, and repeat the dusting and etching for a second and a third time. It must not be understood that we recommend this process to be carried far enough to produce any considerable amount of relief. As a matter of fact, a printer used to the work would produce sufficient with one dusting and etching; but the beginner is asked to err on the right side by giving the work plenty of resin. If too much relief be given, an impression will probably occur from the sides of the lines as well as from their tops, and the work will have a

thicker appearance than if only etched in the manner usual for hand-printing. The etching having been finished, the resin must be removed as follows: Wash off all trace of the acid, gum in, and remove the ink and resin with turpentine to which some oil, transfer ink or other fatty matter has been added. This is very important, because, as a rule, the work has been newly transferred or drawn on the stone, and sufficient time has not been given for the subject to take firm hold of it, and, under such circumstances, there is great risk in using turpentine alone. For the same reason it is important that the sponge and cloth used previously to re-inking should be quite clean and free from any trace of acid or sour gum. The stone must now be re-inked, gummed and dried, and is then ready for working.

Inking.—This process naturally divides itself into three parts—1, the distribution; 2, the refreshening of the surface of the rollers by means of the "riders"; 3, the quantity and properties of the ink. We will treat of these in regular order.

Distribution.—By this term is to be understood the spreading of the ink in an even manner over the surface of the ink-table and the rollers. Some patented machines have special contrivances for this purpose, of more or less practical use, but there are tolerably efficient means common to all machines which must be mentioned here. The principal distribution is effected by setting two or more rollers obliquely across the machine, so that when the ink-table passes beneath them they will roll over it in a diagonal direction, and by setting them to run opposite ways, the distribution is doubled.

The refreshening of the surface of the roller is effected by the riders before mentioned. When the roller passes over the wet stone, it becomes much smoother on its surface, and somewhat damp, which would in a degree render it less effective in leaving its ink upon the drawing in the next revolution, but as soon as it comes in contact with the upper roller this glazing is destroyed.

The quality of the ink to be used for any given job will depend upon various circumstances, which the printer must duly take into account. The chief elements in the calculation are quality of paper, speed of machine, quantity of ink requisite for each impression.

As a general rule, the greater the speed at which the rollers run, the less tenacious must be the ink. The pressman must here be cautioned against confounding this speed of the rollers or table with the number of impressions printed in a given time; it only corresponds in the same or nearly similar sized machines. If one machine has a traverse of six feet for its table, and another four feet, and both are printing 500 per hour, the rollers of the former will be running at the rate of 100 feet per minute, while the speed of the latter will be only about 66 feet in the same time. This may be taken only as a general proposition, because the amount of water used in damping must also be taken into consideration. We may, however, embody this in another proposition: The more water is used for the purpose of damping the stone, the thinner and more greasy may the ink be.

How to Reduce the Tenacity of Ink.—Without specifying in this place the circumstances under which thin

ink is to be used, we will give the modes by which the tenacity of ink generally may be reduced.

First. By thin varnish. We must, however, be cautious not to add too much to the ink, or the impressions will be pale when a proper amount is used on the rollers, while, on the other hand, if sufficient of such thin ink be employed to yield black impressions, they will be so overcharged as to be blurred; the close parts will run together, and the work will easily set off when a few sheets are placed upon each other. To combine thinness with depth of color, we may add:

Second. Oil, either raw or boiled.

Third. The addition of certain solid fatty matters will render the ink less tenacious or stringy without increasing its fluidity. The main object is to make the ink part readily from the roller to the stone at an increased speed, and as some solid fatty matters are found to effect this without thinning the ink, they answer some kinds of printing better than the softer and thinner materials.

The less water used in damping the stone, the stronger and stiffer may be the ink. Though this may be remembered as a general rule, yet it not to be forgotten that the circumstances of speed, and the nature of the paper and the subject, must also be taken into account.

Setting the Stone in the Press.—When care is exercised in putting the work on the stone, scarcely any alteration is needed in fixing the front stop for different stones; but should any be required, the way to do it will be obvious. For bringing the stone approximately to the proper height, some machines are provided by the makers with a gauge to be set across the table, and to this gauge

the stone is raised before being tried by taking an impression.

If the stone is found uneven, packing must be resorted to, as in the hand-press.

Starting the Press: Inking.—When the press will not permit of the rollers being set so as to run upon the ink-table while they do not touch the stone, the stone should be lowered in its bed, or taken out of the press while they are being prepared for inking; or the inking may be seen to before the stone is put in the machine. After the rollers have been scraped, a little ink may be applied to the wavers or distributors, and the machine set running until it is properly distributed over all the rollers. Though nearly all presses are supplied with an ink duct, the beginner is recommended to apply his ink in the same manner until he has mastered the working of the machine in a sufficiently general manner as to be able to turn out a fair quality of work. This will be facilitated by moving the distributors about and turning them end for end.

Damping.—The damping rollers have already been described, and we have now to speak of the actual wetting of the stone when printing.

Some presses are provided with arrangements for damping that are intended to be more or less automatic, but however perfect they may be they will always require attention.

After the damping rollers have become dry, care must be taken that the newly applied water penetrates them thoroughly before proceeding to print.

The degree of damping will greatly depend on the kind of ink in use. The machine minder will find it nec-

essary to watch the work, sponge in hand, and to apply the water where most wanted, which is usually at the edges, and sides, and occasionally to sponge the damping slab, or rollers, so as to keep up the supply.

The proper regulation of the water is more difficult than that of the ink.

CHAPTER XXIII.

PROPER CHOICE OF PAPER—REGISTERING—SETTING A STONE FOR REGISTER—COLOR PRINTING—COMPOSITION AND GLAZED ROLLERS—THE INK-DUCT—DEFECTS IN INK-DUCTS.

INTIMATELY connected with the subject of cylinder-press printing is that of the proper qualities and descriptions of paper to be used, and we may advantageously devote a few paragraphs to it. We may say at the outset that it is to be regretted that clerks and travelers who take orders for printing do not make themselves better acquainted with the fitness of papers for the various kinds of work. The proper choice of paper in many instances makes all the difference between good and bad printing, and a suggestion from the person who is taking the order would, we think, be generally favorably entertained.

Writing, drawing, loan or other hard-made English-sized papers should never be used for printing upon when beauty of impression is the chief consideration. The use of such papers should be restricted to note, letter and invoice heading and other similar work, in which the appearance of the printing is secondary to its use for writing upon.

To produce the best printing, the paper must be somewhat absorbent, and that is the well-known character

of printing and plate papers, the latter being still less sized than the former. If a good printing paper be well glazed, it will resemble writing paper sufficiently to be used for circulars and such-like work, and will take a much better impression than can be got upon the harder sized material, while it will bear writing upon well enough for all ordinary purposes of adding names, prices, etc.

Now, suppose a smooth, hard-sized writing paper is to be printed, let us study the circumstances: First. Too much water must not be used, or the surface will be injured. Second. The minimum quantity of ink that will produce blackness must only be employed, so as to prevent the setting off to which such paper is very liable, and to facilitate the drying. Strong and medium varnishes will print cleanly on slightly damped stones, but would not do for this purpose because too much ink would then be required for the kind of paper we are supposing to be used. The ink must therefore be thinned as little as possible with weak varnish, or even oil, with a little dryers, and the machine be run at such a speed as will permit of such ink being used, when, with proper management, good work will be produced.

Such being the principles involved in working hard-sized paper, it is not difficult to comprehend what is to be done when the paper is more absorbent, and the following general rule gives the key to the whole: The more absorbent the paper is, the more water and ink may be used, the thinner the ink may be, and consequently the higher may be the speed of the machine.

Registering at a good press can be performed with greater facility and exactitude than at hand-press, when

once the stone is properly set; but to insure success it must be driven at a moderate and uniform speed, and the stone be so beveled on the edge that first meets the cylinder that it may cause no jolting or other motion tending to move either out of its place.

It is almost impossible to overestimate the importance of register in lithographic machine printing, and any suggestions which are likely to be of assistance to the printer in this matter will no doubt be welcomed.

Variable atmospheric conditions, insufficiently matured paper or constitutional defects in the machine are frequent sources of inaccurate register. These may be to some extent unavoidable and therefore beyond the printer's control, but there are numerous other points which have an important bearing upon the accurate fitting of one color or form with another, and therefore require care and attention. The following method of procedure is well worth consideration, as it has decided advantages over many others:

The key, or outline form, to which the color forms have been set up, is put into the machine at the beginning of the printing operations. The exact position of the design on the sheet is arranged, and twenty or thirty impressions taken on a reliable paper. With these impressions as a guide, it is a comparatively easy matter to register each color accurately. This effects a saving both in time and material, and rarely fails to produce satisfactory results. During the early stages of the printing, when it is difficult to detect any slight movement of the stone in the machine, a sheet bearing an impression of the key may be printed in the usual way, when

any variation in register will be revealed at a glance. The relative positions of the side lay and gripper seldom receive the consideration they ought to have. The gripper and side lay should be exactly at right angles to each other, and any divergence whatever from this rule simply courts disaster. If they form an acute angle, there is danger of the sheet moving forward a little as the gripper closes. If, on the other hand, they are fixed at an obtuse angle, there is a proportionate risk of the sheet falling back as the gripper closes. If any degree of uniformity could be guaranteed in these movements, then all would still be well, but unfortunately no such guarantee can be given, owing to a possible variation in the cutting of different batches of paper.

Another matter of a similar character and quite as important in its issues is more directly connected with the gripper.

The continuous type of gripper is probably the best for general use. It enables the printer to use two or more pins upon which to rest his sheet, according to the particular requirements of his work. Two pins are usually sufficient, and answer best, for the following reasons: It is by no means unusual to find that the paper, trimmed though it may be, has slightly convex or concave edges, owing either to insufficient damping or an inaccurate setting of the knife in the guillotine cutting machine. This can, of course, be avoided, but the point at present under consideration is one of possible effects.

Setting a Stone for Register.—Take a straight, wide, but thin piece of metal long enough to rest on the racks of the table; through each end and into a tooth of each rack

drill a small hole. To each hole of the metal strip fasten a pin to just fit the hole in the tooth of the rack. It should now be easy to set this strip accurately to these holes at any time, and if register marks be put upon the stone to correspond to the edge of this rule, the stone may be rapidly adjusted in register without taking an impression.

Color Printing: Rollers.—In color printing one of the most essential conditions is clean rollers, and one of the best means of obtaining them is to have two sets (besides the black ones), one set being kept for tints and another for the stronger and darker colors. When there is much color work done, we should even recommend three sets, as it would be very advantageous to keep one for yellow, red and orange tints, and another for dark blue, green, purple and the tertiary colors.

Washable Rollers.—Attempts have from time to time been made to manufacture rollers for lithographic printing having the advantages of the composition of glue, treacle, etc., used by letterpress printers, and thus making one set do for all purposes; but on account of the soluble nature of the materials much difficulty has been experienced in making them work upon the wet stone.

Glazed rollers are much used on cylinder presses, and may be prepared for such use in a similar manner to hand-rollers. After the drying ink has been well distributed upon them, the riders (if used) are to be taken off them, and the rollers run over a wet stone until they become nicely smooth; they are then allowed to dry, after which the operation may be repeated, alternately rolling them up and drying them until they are quite smooth upon the surface.

The Ink-duct.—There is great difference of opinion among lithographic machinists as to the value of the ink-duct. We think their non-use may be traced to three causes: First, the printer does not like to grind a large quantity of ink, to add dryers which prevent its keeping, and then have to throw the unused portion away; second, a want of mechanical knowledge of the capabilities of this part of the press, and a lack of delicacy in regulating the adjusting screws; third, faulty construction of the mechanism.

Defects in Ink-ducts.—Passing over causes No. 1 and No. 2, we have something to say as to No. 3. The ink-duct may be faulty by reason of the knife not fitting the ink-cylinder, but this may be cured by grinding the knife. The greatest fault, however, is that of the ink-cylinder being kept constantly running, as it is in some machines.

Speed, as has already been pointed out, is a very important factor in lithographic machine printing. It has become quite a necessity, and everything which conduces to it should receive the most careful consideration. Economy of power is too seldom regarded as a standard of efficiency in the printer. At any rate, as far as this is concerned it is doubtful if he fully realizes the effect of what may appear to him as insignificant matters. A little pressure more or less on the stone may be in itself a mere trifle; so also would be a careless arrangement of the inking rollers or indiscriminate damping of the stones, yet, when taken together, what a considerable waste of power they might cause—a waste which is altogether unnecessary and could easily be obviated by care and forethought. Excessive pressure is frequently resorted to in

order to "bring up" an impression which is defective owing to some error of judgment in its preparation. It undoubtedly secures the desired effect, but at what a cost! There is a proportionately heavier drag on the machine and a greater strain on its most vital parts. The following view of this matter may be regarded as somewhat exaggerated, but it is by no means an uncommon state of affairs, and will at least serve to emphasize the importance of this point: It is a popular fallacy to suppose that in adjusting the litho. stone to the bed of the printing machine it should be made perfectly level. As a matter of fact, a much easier and more satisfactory impression can be made from a stone which is worked just a little higher at the front or gripper edge than at the back, and for this reason: The drag on the cylinder as it makes the impression is appreciably greater at the back than at the front, and when the pressure is heavy it has a tendency to leave the back edge with a very decided jerk. The remedy is obvious and simple. As already suggested, the stone should be set in the machine with the least possible inclination toward the front. This adjustment is easily effected by a judicious arrangement of a few layers of brown paper. Just think for a moment of the effect likely to be produced by such a jerk or jar, which would under ordinary working conditions occur from twelve to fourteen times per minute while the machine was in motion!

We think we have now given nearly all the information on this subject that can be conveyed by means of writing. For the rest, we recommend practice, study and perseverance; and with these may be built up a valuable experience.

CHAPTER XXIV.

Miscellaneous Processes and Recipes.

SOAP as a Lithographic Material.—Soap consists of an alkali in combination with a fatty acid. The alkalies used in soap manufacture are soda, potash and ammonia; the acids are chiefly oleic, stearic, palmitic and margaric. Soda forms the "hard" soap; potash, the "sweet" or soft soap; and ammonia, the kind of soap used in medicine, technically called liniment. Soda soaps will vary in hardness according to the acid employed. Stearic and margaric acids yield harder soaps than the oleic and palmitic. Soap, although it is of so much importance, is one of the least reliable compounds which the lithographer has to use. Best white or yellow is what we employ. Seeing that soap may by dextrous management be made to contain 80 per cent of water, that 20 per cent may be considered a minimum, and 40 per cent an average amount, it is no wonder that various results are obtained from apparently the same material. Supposing that it is desirable that soap for lithographic ink should consist of stearate of soda only, there is little chance of securing it of pure quality, when various samples of commercial soap are found to contain the following substances: Glycerine; silicate, sulphate, chloride and carbonate of soda; rosin; gelatine; fuller's earth; Cornish clay;

ground flints; potter's slip; farina; dextrine, and other substances.

The principal object of the soap in lithographic ink is to render the other ingredients soluble in water; and any considerable quantity beyond that will be of doubtful benefit, because the more soap the ink contains the more liable it is, when dissolved, to pass from the state of a liquid to that of an emulsion. It is desirable, then, that the soap should maintain a proper proportion to the other ingredients, to effect which it must have the water removed from it by drying.

Cut the soap into thin shavings or scrape it with a piece of glass; set it upon a dish before the fire, or on the hob, until quite dry. A cleaner way will be to put the shavings into an earthenware jar; set that in a saucepan of water and allow it to boil, and maintain it at that heat until the soap is quite dry. It may then be preserved in corked bottles for future use. Soap for chalk-making may be treated in the same way.

Lithographic Writing and Drawing Ink.—Many recipes for this ink have been published from time to time, but the one to which we give preference is one of the oldest of them, having been published in France about sixty years ago:

Take of Tallow	.....	4 oz.
Wax	.....	4 "
Soap	.....	4 "
Shellac	.....	4 "
Fine Paris Black	.....	Quant. suff.

This recipe makes the best ink we have ever used for drawing on stone, though for transfer paper we have

thought we have improved it by adopting the following proportions:

Tallow	4 oz.
Wax	5 "
Soap	4 "
Shellac	3 "
Black	About half the quantity used for stone.

For retouching the latter ink is excellent, as it will frequently hold firmly to the stone, if only well washed, without any acidulous preparation; not that this course is to be recommended, it being mentioned only to point out the quality of the ink.

Recipes are frequently of very little use unless accompanied by a description of the precise manipulation; and we think we shall be able to point out a mode of making lithographic ink that, if followed, will lead to success:

Take a small saucepan (one that will hold a quart will do for the above quantity) and fit a handle of wood inside its iron one, so that it may be about a foot longer. This will enable the operator to have command of it when its ordinary handle becomes too hot. Make another wooden handle 12 inches long, and fit it to the handle already upon the lid in such a manner that it may, when on the saucepan, project horizontally. If the flame in burning the ink should become too high, it may be removed from the fire, and by means of the handle last described the lid may be put on without fear of burning the fingers, and the flame extinguished by cutting off the source of oxygen—the external air—without which it does not burn. These simple contrivances will render the operation a safe one with persons of ordinary care and intelligence, and will

enable them to devote their attention more satisfactorily to the ink manufacture. Put any kind of oil or rough fat into the saucepan and heat it until its tin lining becomes melted, when it and the oil may be poured away together; or the saucepan may be gradually brought to a red heat and the tin burned away. We prefer the first method.

The fire for ink-making should be a clear one, yet not low, as the operation will require a considerable time; putting on new coals would perhaps cause a flame to play around the saucepan and set fire to its contents at an inconvenient moment.

Put into the saucepan the tallow and wax, and when melted throw in the soap a little at a time. Contrary to the teaching of some manipulators, we can assure the student that it is not at all essential to have the soap previously dried, if caution be observed in putting it in. The principle is this: Common soap, as shown in the last paragraph, contains a considerable quantity of water, which is readily parted with at its boiling-point. The tallow and wax in the saucepan soon exceed this heat, and when the soap is thrown in, its water is violently expelled; and if too much be added at a time, the whole may boil over into the fire and cause mischief; but if it be thrown in in small pieces, and time be allowed for each piece to part with its water (which may be known by the cessation of the ebullition it at first causes), its solution in the wax and tallow may be safely performed. When this has taken place, the heat must be continued until the dense light-colored fumes passing off can be ignited upon the application of a light. If the flame be two or three inches high, the saucepan may be removed from the fire, when the burning will most probably be continued with-

out further application of heat to the bottom. Stirring with a rod will facilitate the passing off of the vapor, and will raise the flame higher. If the quantity herein named be used, it may be burnt perhaps for half an hour; but whether a longer or shorter time be involved, it must burn till the twelve ounces are reduced to nearly eight. This may easily be found by weighing the saucepan at starting and afterward making an allowance for that weight during the burning. Arriving at this stage, put out the flame and add the shellac a little at a time, taking care that it does not boil over. Add now the black.

We do not allow the mixture to ignite after the shellac and black have been added, because it is apt to form a carbonaceous crust on the top. If afterward it is found, as it probably will be, that the burning has not been continued long enough, it may be again heated, and the effect estimated by observing the density of the light-colored vapor passing off.

It is important that the black should be ground. This cannot be easily done with any of the ingredients used for the ink, but if it be ground in turpentine and cautiously added to the ink, the heat will vaporize the turpentine, whose place will then be taken by the other molten ingredients, whereas if it were added in the state of dry powder there would be considerable difficulty in properly diffusing it throughout the mass. Good lithographic printing ink, in the same condition as bought from the maker, may be used for this purpose if an allowance be made for the small quantity of varnish with which it is ground.

Considerable difference of opinion appears to exist as to the amount of black to be used. On reference to formulæ in our possession, we find it variously stated at

from one-sixth to one-twentieth of the whole. The following considerations may decide the matter: First. All blacks are not equally powerful. Second. Ink for use on stone may have more than that for use upon transfer paper. Third. Ink with little black makes purer and finer lines with the ruling-pen than that which has much. Fourth. Ink for transfer paper should show a gloss when it becomes dry in the saucer, and the color of a thin solution should be brown rather than gray. In practice it is better to err on the side of putting too little than too much black, because the former can easily be remedied.

The ink, having been brought to this stage, requires now to be tested to determine whether it is sufficiently burnt, and we believe we can claim the credit of being the first to draw attention to, if not to discover, a simple method for determining this important point. Ink that is not sufficiently burnt becomes thick and slimy on standing for two or three hours after mixing with water, but our method shows at once whether it is burnt enough. Place about a grain or so on a saucer, and drop upon it a little distilled water; watch it for a few seconds, and notice whether the ink appears to become lighter in color; if it does, it is a sign that the burning has been insufficient. Heat again, and allow the white fumes to pass off for a few minutes without catching fire. Try the ink again. When it retains its blackness upon the addition of water, we have found that it will also keep in a good working state, and have made it for law-writing, by the pint.

The ink, having been proved, may now be cast into sticks for convenient use.

Other substances, such as gum-mastic and Venice turpentine, may be used in making ink.

Type Re-transfer Ink—or Ink for Stone-to-Stone Re-transfers.—Melt two ounces of lithographic writing ink in a saucepan over the fire. While this is melting mix two ounces of litho. printing ink with two ounces of varnish, add it to the writing ink, and well mix the whole while it is hot. This may be set aside for use, and will keep indefinitely.

Ink for the Dabbing Style.—This may be made as the last, with the varnish omitted.

Plate Transfer Ink.—The making of re-transfer ink for taking impressions from copper plates is conducted in the same manner as that for writing and drawing.

Lithographic Crayons.—These are made in precisely the same manner as the ink, and may even be made of the same materials if they are burnt sufficiently hard for use in drawing. A good, useful chalk that will keep well can be made from equal parts of wax and dry soap.

Crayons may be cast in the flat cake and then cut up with a saw or hot knife into square pencils, but they are better cast in a grooved box similar to a druggist's pill-machine, and pressure applied while hot.

Crayons may be well kept in wide-mouthed bottles tightly corked.

SENEFELDER'S COMPOSITIONS FOR CRAYONS

No.	Black	Soap	Wax	Tallow	Shellac	Spermaceti	
1	2	6	4	—	—	—	parts
2	2	4	8	—	—	—	
3	2	4	4	—	—	4	
4	2	4	8	—	—	4	
5	3	5	8	—	4	—	
6	3	5	8	2	4	—	
7	3	6	8	4	—	—	

Lithographic Varnish.—Put two quarts of the best linseed oil into a saucepan large enough to hold a gallon. The lid should have a long handle, so that it may be put on the vessel with safety while the contents are burning. Set it on a clear fire until white fumes arise. Apply a lighted paper occasionally until these fumes catch fire and burn. It must now be watched carefully, so that the flame shall not become unmanageable. If the flame goes down a little, it may be increased by stirring with an iron rod. If it shows a tendency to rise too high, it may be removed from the fire, when it will still continue to burn. If it rise too high and threaten to become dangerous, the lid must be put on, when the flame, being deprived of the access of air, will be extinguished. If the flame has been very high, the lid should be kept on long enough to allow the whole of the oil to cool down a little, for if it were merely extinguished and reopened it would take fire spontaneously and flare up nearly as much as before.

The oil is burnt until it becomes one-sixth less. A thick slice of bread is now put in and moved about with a fork until it is browned. It is then allowed to burn a little more, it being set on the fire again to revive the flame if the latter has become dull. A second slice is now put in and cooked in a similar manner. This proceeding is said to free the oil from its more greasy particles.

One-fourth of the oil may now be taken away. If on becoming cold it is of a syrupy nature, it may be set aside for thin varnish.

The rest having been burnt again for a short time, a third part of the rest is to be taken away. This is medium varnish.

The remainder is again burnt, and one-half of it set aside for strong varnish.

The fourth portion is again burnt, and when cold it should be thick and ropy.

If these varnishes are not as strong as expected, they may be burnt again until they become of the required consistency.

It is necessary to take every precaution to guard against accident. The operation should not be carried on in an ordinary apartment, but in a back kitchen or other place where there are few things about likely to catch fire or be spoiled by an accident.

Transfer Paper.—In an early chapter we explained the general nature of transfer paper, but now we give a few recipes.

In making papers for transferring, care should be taken to select the proper material, so that when coated with the transfer composition each paper will be best suited for the work for which it is intended.

For autographic work a good, smooth bond paper should be used. This same paper can be used for typewritten work, the only change necessary being the use of a black ribbon to which some transferring ink and a drop or two of lavender oil have been added.

For transferring from engraved stones, the best paper is India or Japanese paper, which has a pliable body, is readily dampened, and enters into the engraved parts of the stone under moderate pressure.

Label.—For ordinary label work, French folio is best. It is a closely woven and rolled paper, and in color work will not distort easily.

Many labels must be got out at moderate cost and on cheap grades of paper, which oftentimes will stretch or shrink in the press during the printing of the colors. In such cases transparent transfer paper is of much value, as it allows the pasting up of impressions to a sheet of the run of the steam press. To insure a perfect register, even on a cheap grade of stock, tracing transfer paper should be used, which is made of French tracing paper covered with the same transfer solution used on the papers previously mentioned.

Type.—For making transfers from type on an ordinary type press, use lightweight coated stock covered with a firm, smooth coat similar to paper first mentioned above. It frequently happens in the making of type transfer impressions scraps of India transfer paper are sent to the type-press room. It is evident that if a soft-bodied paper be used for that purpose the type impressions will be indented in the paper to a greater extent than if a hard-bodied paper be used. Experience proves that even with the greatest care transfer work spreads more than original work. Therefore, if a type transfer impression is not pulled as sharply, clearly and with the least possible indentation to the transfer paper, the resulting transfer will bear a thick, heavy appearance when compared with an impression on paper from the same types.

Transfer Composition.—A good coating for transfer paper can be made from four ounces of starch, eight ounces of French glue or gelatine, both of which have been soaked in sufficient water to thoroughly soften them. Sixteen ounces of boiling water should be poured slowly into the starch, stirring same steadily. When

thoroughly cooked, add first the French glue or gelatine, then six ounces of glycerine to produce papers number one, three, four and five. To transfer paper for engraved work, use ten ounces of glycerine. A drop of gum, with a little coloring matter, will show which side of the paper carries the coating. The addition of the white of one or two eggs, thoroughly beaten, to this composition will improve its transferring qualities.

In practice the imported paper and the French folio paper are dampened, previous to their use, on the back with a mixture of one ounce of glycerine to two, three or four ounces of water, which will keep the transfer coating of the paper moist from twelve to twenty-four hours. This dampening solution must vary according to weather conditions, as on a dry day more glycerine is necessary to keep the paper in a moist condition than on a damp day. Experience can alone determine this. In all large establishments a supply of wet, medium and dry papers are always kept on hand. Many varieties of the coating composition can be tried and worked successfully, but the use of one simple and sure composition is preferable to too many experiments.

Columbia paper, which is made in two grades, moist and dry, which is exceptionally useful and also reliable for fine color transferring, is imported from Germany. It is a machine-made product, uniform in quality throughout, and, for that reason, superior to a hand-prepared paper. For all practical purposes, however, the papers enumerated above, which can be easily prepared with very little trouble in any establishment, will prove their value and usefulness.

Transfer Paper for Warm Stones.—Make a size by boiling parchment cuttings. Let it be so strong that when cold it will be firm jelly. Grind dry flake-white with water, add it to the size after warming it, well mix, and rub through a sieve. The proportion of flake-white may vary with circumstances. If too much be used, pens will not work upon it properly, and probably the finest lines will fail in transferring. Coat the paper with the composition with a full brush, or use a sponge, and give two coats—the second when the first is dry. If for writing, the paper may be thin; if for drawing, it should be thicker, using drawing paper for very large subjects. The stone for this paper should be quite warm.

Paper for Cold Stones.—Take four ounces of starch and one ounce of best pale-colored glue. Break the glue and put it in cold water over night to soak. Mix the starch with a little cold water, and then pour boiling water upon it until it thickens, stirring it all the time. Now put in the glue, and boil over a slow fire or gas-jet; brush over the paper while warm. This may be used on tracing paper, printing paper or writing paper.

Coloring Transfer Paper.—The addition of coloring matter to transfer paper is for the more ready determination of the coated side. Gamboge is generally used, but any kind of coloring matter will answer the purpose. We somewhat prefer a light pink tint, because that is distinguishable by artificial light, while a yellow is scarcely visible. Rose-pink, or a solution of cochineal in ammonia, answers this purpose.

Glazing Transfer Paper.—The paper may be pulled through the litho. press, face down, on a smooth stone;

but it is much better to send it to a hot-presser to have it properly rolled.

Hanging Transfer Paper Up to Dry.—Put lines across a room, about nine inches apart. Lay the wet paper over T-shaped piece of wood, and place it on the lines neatly and cleanly.

Scotch Re-transfer Paper for Plate.—The recipe for this paper has been given in many works treating of lithography, but, so far as we are aware, always unaccompanied by the details of manipulation, without which the formula is comparatively worthless.

Take of plaster of Paris and best seconds flour equal parts by weight, to which add sufficient coloring matter to be able to know one side from the other either by daylight or artificial light. We recommend something of a red or green hue, because that can be more easily distinguished by gaslight than a yellow tint.

To Prepare the Plaster.—In this lies the secret of success. Obtain the best fine plaster from the manufacturer of plaster of Paris images, etc. That to be found in country towns in use by plasterers and others is usually so coarse as to be worthless for this purpose. Put half a pound of plaster into a basin that will hold about two quarts; pour upon it a little water and mix it up with a wood spatula until of the consistency of cream. If it were now let alone it would soon set into a hard, stone-like mass, but this must be prevented by constant stirring and the addition of small quantities of water whenever the plaster shows a tendency to thicken. This constant stirring and watering will occupy half an hour, by which time the "setting" quality of the plaster will be

destroyed, and may be left while the paste is made from the flour. Mix half a pound of flour into a smooth paste with a little water, then add sufficient water to make it into paste of ordinary consistency when boiled. Set it on the fire while cold, stir it constantly until it boils, and let it boil for five minutes. The saucepan should be large enough to hold twice as much, and the fire a slow one, or the paste may be expected to boil over. If this should happen, some will be lost and the proportions destroyed, when it will be better to make a new lot than to run the risk of spoiling the transfer paper.

The paste is now to be added to the plaster and well mixed, after which it must be passed through a piece of cloth or fine sieve (the 120-hole sieve for sifting graining sand will do admirably) by putting in a little at a time and rubbing it through with a stumpy hog-hair brush. When all has been passed through, the composition may be applied to the paper with a large flat camel-hair brush about four inches wide. If any difficulty is experienced in spreading it evenly, it may be too thick, and can be diluted with water to a proper working consistency, a matter to be determined by experience. Our practice is to brush it on in one direction, and then to lightly brush it at right angles until it presents a uniform layer of about the thickness of thin cardboard. We recommend the beginner to use a tablespoon or other similar convenient measure for measuring an equal quantity for each sheet; by adopting this method sufficient composition may be applied at one operation. Some recommend two coatings to be given with a sponge, but a sponge is not at all suitable for laying it on; something is required that

will glide over the surface and leave a body underneath. If some suitable coloring matter be used, it will materially assist the beginner by enabling him to see whether the composition is laid on evenly. The sheet, having been coated, is to be hung on a line to dry as in making other transfer paper. A thin demy printing paper, about fifteen pounds to the ream, will be good enough for this purpose.

Red and Black Tracing Papers.—The preparation of these is very simple. Tissue paper is a much better foundation than tracing paper, the varnish of which is apt to unite with the coloring matter and prevent its transference to the stone. Lay out the paper upon a smooth board, sift upon it some powdered red chalk or black lead and rub it in, being careful not to tear the paper; when the paper is well covered, the superfluous color may be first removed with a hard brush and finally wiped with a cloth. Its effect may now be tried on stone or paper. If it is too dark, more color may be removed with a cloth.

Red chalk paper should be used for lithography, and blacklead paper for designs, etc., on paper, because the blacklead can be removed with india-rubber, though the red chalk may be removed by bread-crumbs.

Chrome yellow may be used for paper employed in tracing on black grounds in engraving on stone; when the color of the ground is red, fine Paris black makes the best tracing paper (see Engraving on Stone).

Transfer Papers for Re-transferring Color Work.—The Scotch transfer paper will answer almost every purpose for re-transferring where correct register is not re-

quired, as in the multiplication of color subjects. For this purpose thin foreign post paper may be coated with starch paste and afterward well rolled when dry, so as to restore its semi-transparency and render it in other respects suitable for the purpose. Stout tracing paper may be employed with the same treatment where a more transparent paper is required. Copying letter paper may also be employed. When the main object, of seeing the work sufficiently well through the paper, is secured, it only remains to give such a coating as will take a good impression and stick sufficiently to the wet stone.

Transfer Paper for Chalk Drawings.—Stout printing paper is thickly coated with the Scotch transfer composition, to which a little glue has been added. After drying, it is rolled on the stippled plates, or pulled once through the press under heavy pressure on a grained stone.

Porcelain or Enamel Paper.—This paper is employed in printing where brilliancy of effect is sought, whether for color or bronze work. Although we do not wish to recommend its manufacture by the printer, it will be as well for him to understand something of its make and properties.

Ordinary enamel paper is prepared by brushing over common printing paper a mixture of flake or Kremnitz white with fine light-colored glue and a little alum. The glue must be only sufficient to prevent the white from peeling off the paper during printing. If too much were used, the paper would be hard and non-absorbent. If zinc-white be used instead of the lead-white, it will be less liable to change color in impure air. The mixture may consist of 4 oz. of Russian glue dissolved in 3 quarts

of water; in this grind 1½ lbs. of zinc-white and pass through a sieve. Apply two coats. When dry, the paper may be polished by brushing with a somewhat hard hair-brush, and subsequently further glazed by rolling on polished metal plates.

We believe that sulphate of baryta is sometimes used instead of zinc-white, and that a mixture of white, turpentine, and oil varnish is also used for a similar purpose.

Enamel cards are damped by placing them between sheets of damp paper.

Preserving the Drawings on Stone after Printing.—It is too often the practice in lithographic printing offices to take but little notice of the stone when the first order from it has been executed, but if there is only a remote chance of its being required again, means ought to be taken, as far as possible, to insure that the stone be in fair printing condition when another edition is called for. Drawings may be preserved by using the following ink:

Ordinary printing-ink, as bought from the ink-maker	2 oz.
Tallow	2 oz.
Beeswax	4 oz.

The tallow and wax are to be melted over the fire, and the printing-ink added a little at a time until dissolved.

When about to be used, a small quantity must be ground with turpentine until of the consistency of ordinary printing ink. Wash out the drawing with the washing-out mixture, or with turpentine only, and roll in with the above ink until the drawing shows clearly, using a small quantity of gum on the stone to keep it quite clean.

Set the stone aside for a few hours until the turpentine has quite evaporated, and then gum in with gum-water containing carbolic acid.

Another Method: Roll the stone with ordinary printing ink. Dust with powdered resin and allow time for the ink and resin to incorporate and become hard. Take a spoilt impression of the job, and brush over the back of it with gum-water; lay its gummed side to the stone and pull through the press. Gumming the paper instead of the stone will more effectually exclude the air, and thus prevent "oxidation" of the ink, for which "drying" is only another name. The resin, having no tendency to dry, will very materially assist the preservation of the ink in such a condition as to be soluble in turpentine.

If the stone is to be laid by in a very dry place, the addition of a little glycerine to the gum will prevent its cracking. It is better than sugar, molasses, etc.

Rolling Up Drawings that Have Been Laid Aside For a Long Time.—First try the effect of turpentine mixed with a little oil after the gum has been moistened. If this does not remove the old ink, gum the stone again, dab it over with the damping cloth so as to prevent the gum overlying the ink and allow it to dry. Turpentine may now be permitted to lie upon the stone until the ink is dissolved. If turpentine be ineffective in softening the ink, benzoline or oil of tar may be tried. It must be understood that no water be employed, so that the gum remains undissolved and so thoroughly to protect the uninked portion of the stone from receiving any greasy matter. If the ink still resists the action of the solvent friction may be employed. The solvent may be employed

with coarse flannel, and may even be assisted by the addition of some abrading material, such as chalk, tripoli, rouge, or Indian red. These will have little or no effect on the gum, and when sufficient ink is removed, the stone may be washed with oil and turps, the gum dissolved with water, and the stone rolled up in the usual way.

Transferring from Music Plates.—Music is usually engraved by punching the forms of the notes, etc., on soft white metal plates, which will not stand the heat employed in taking transfers from copper and steel plates. As the music contains no fine lines, it is unnecessary to employ the hard ink used for finer work. The music plates may be filled in while cold with the ink used for pulling re-transfers from stone, and wiped from the surface with rags in the usual way. The scum left on the plate will be considerable, and if the impression were pulled upon the ordinary transfer paper, would give much trouble when transferred to stone.

To Prevent Set-off on Stone.—Anti-Damping Fluid.—When it is necessary to print two or more colors in succession without time being allowed for drying, the color first printed sets off upon the stone. If it be a black or similar color followed by a delicate one, such as bright red, the black set-off will be taken up by and soil the ink upon the roller. This may be much modified or altogether prevented by adding to the damping water some substance which retains moisture a long time, such as sugar, common salt, glycerine, chloride of lime, etc. These may be used separately or in combination with each other, or with gum.

Backing Stones.—When stones less than two inches

thick, or even thicker ones when large, are used in the press, they are apt to break when much pressure is employed. Such stones are best "backed" with slabs or slate or other lithographic stones. It is performed as follows:

Mix up ordinary plaster of Paris to the consistency of very thin paste, spread this upon the slab, and place the stone upon it. Move it about until it is felt to rest pretty firmly upon its seat. By this time much of the plaster will be squeezed out from between the stones, and should be neatly plastered round the base of the upper stone, so as to better secure it. If the plaster be new the stone may be used in the press in about an hour.

Enlarging and Reducing Processes.—There is no doubt but that the photo-lithographic process is the most efficient means of obtaining copies for lithography in altered dimensions. There is, however, another process which possesses advantages of its own, and which, unlike photography, can be carried on at any time. It will be easily understood, if a sheet of thin india-rubber be prepared with an elastic transfer composition, and an impression be made upon it in transfer-ink, that by suitable mechanism it may be stretched to a larger size, and while at that size it may be retransferred to stone. In like manner, if the india-rubber be stretched before the impression is taken upon it, it may be allowed to contract to a smaller size before it is re-transferred.

Quick-drying Stopping-out Varnish.—Resin dissolved in common benzoline makes a good stopping-out varnish for use in etched tint making, or for any other purpose where it is necessary to protect the work during etching

with strong acid. It dries very quickly—so quickly, in deed, that the stone may be etched a few minutes after it is laid on, and it is easily dissolved by turpentine during the washing-out process.

Economy of Rags.—Rags are used in washing out the black ink previously to rolling up the subject in color, and unless economy be practised, much more will be used than is really necessary. They may be greatly economized by judicious use. Cut them into convenient size pieces. The stone should be sprinkled with a little turpentine and the whole of the ink dissolved before the rag is used to absorb it. The stone is then sprinkled again, and a second rag taken to wipe it with.

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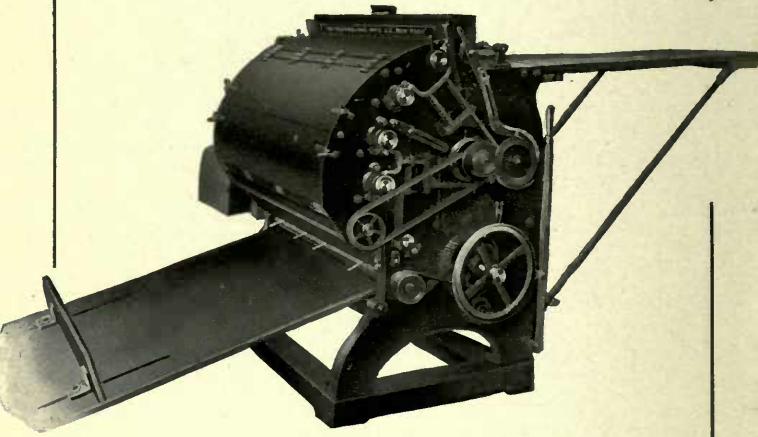

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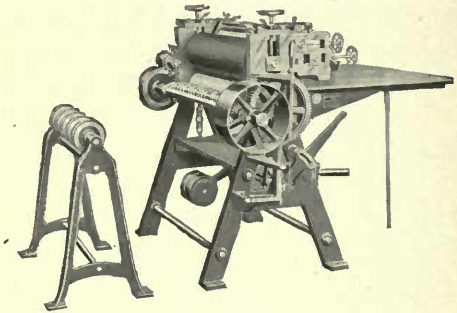

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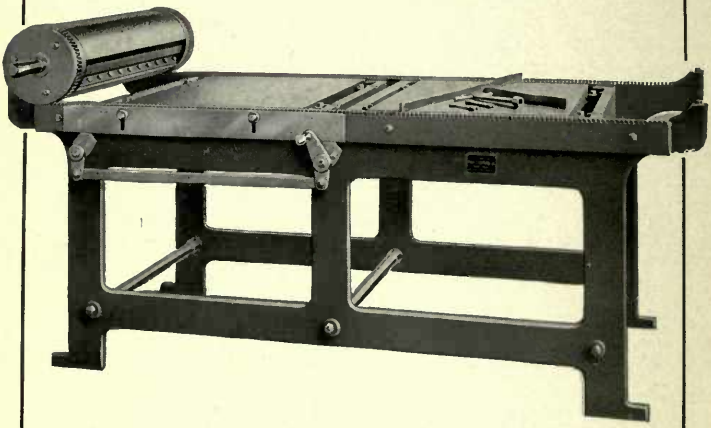

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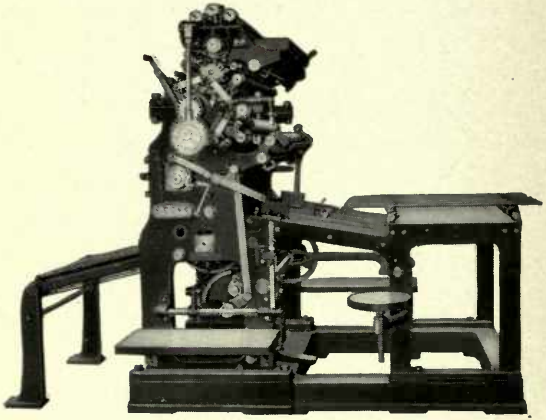

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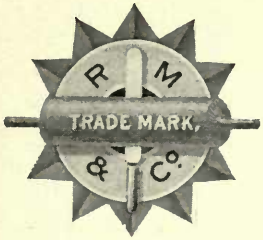

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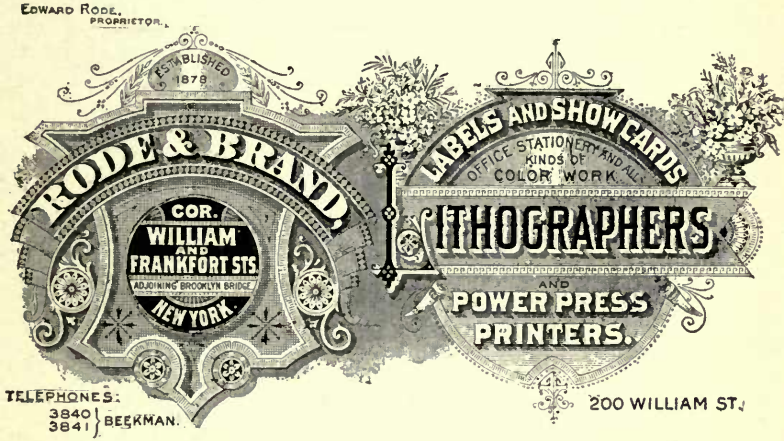

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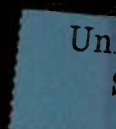
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